2016 SPECIAL ISSUE

MCU Journal

CLIMATE CHANGE & POLICY

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From the Editors

MCU Press (MCUP) proudly offers readers this special issue of *MCU Journal* (*MCUJ*) that focuses on the past, present, and future impact of climate change and policy. While it is not our intent to take a political or philosophical stance on the issue, we do intend to use this medium to inspire discussion on how U.S. agencies and Service branches address the subject based on operational demands, political pressure, and public opinion. Readers might wonder how this global topic impacts the U.S. Marine Corps; however, the two are not such disparate concepts, particularly when we consider the connection between climate change impacts and humanitarian aid and disaster relief operations the Corps has supported as early as 1895.

This special issue of the journal also represents the strategic direction of the new editorial board and MCUP staff who intend to address topics of value to the Marine Corps, Marine Corps University, and the larger Department of Defense community. Our priority, in addition to timely and relevant content, is to engage civilian scholars and analysts, such as J. Brooks Flippen at Southeastern Oklahoma State University; Michael Reis at History Associates Inc.; our partners at CNA, Ralph Espach, David Zvijac, Ronaldo Filadelfo, Catherine Schkoda, Shawna Cuan, and E. D. McGrady; and professional military education instructors, such as Edward Erickson at MCU and Rebecca Pincus at the U.S. Coast Guard Academy. Future issues of *MCUJ* also will include articles written by military personnel who understand the value of their perspectives and the importance of that knowledge not being lost once a deployment or active duty ends. *MCUJ* offers readers truly engaged authors from a myriad of backgrounds, with a variety of professional experience, and whose perceptions are important in the policy world.

The final section of the journal provides readers with several reviews on topically relevant titles and recent books. This includes Philip Shackelford's review of the landmark publication *The Greening of the U.S. Military* by Robert F. Durant, that further highlights the critical nature of climate change and how analysts and academics have framed the issue prior to 2007, a topic seen in sev-

eral of this issue's articles. Edward Melillo's review of *Clean and White* also picks up on how environmental issues affect policy at the local level, contrasting with the national and global issues broached by Durant's book.

In this next year, we anticipate regular issues for both the fall and spring that offer stimulating discussions on such topics as international relations, warfare and counterterrorism, and an in-depth look at the Rebalance to Asia. Feel free to give us your feedback via email or on social media; the journal's editorial staff can be reached on both Twitter and Facebook. We are excited to announce that MCUP and the journal are on the move, entering new spaces in the Brigadier General Edwin H. Simmons Marine Corps History Center that will feature a bookstore on the first floor for readers to pick up our newest releases.

Climate Change and the Department of Defense
An Introduction

Edward J. Erickson

Abstract: The following essay is an introduction to the journal's special issue on climate change and policy. The article gives a general overview of the Department of Defense's policy architecture as related to climate change as a means to introduce key issues, documents, and events related to the articles that follow. The author also details the evolution of climate change policy within the Department of Defense from passive neglect in 2006 to active concern in 2015.

Keywords: climate change, global warming, national security, Department of Defense policy, *National Security Strategy*, National Security Council, *National Military Strategy*, *Quadrennial Defense Review*, foreign and domestic policy, resource scarcity, adaptation, mitigation, geographic combatant command

Scientists have been discussing the concept of climate change since the nineteenth century, but the study of it has become more intense in the last 50 years with new tools, ideas, and terminology in the hands of researchers and their supporters. Moreover, the topic has found its way into the partisan divide that has dominated the U.S. political conversation during the last few years. Thus, it may seem counterintuitive to some Americans that the U.S. Department of Defense (DOD) fully embraces the idea that global climate change is an actual risk to national security that must be taken into consider-

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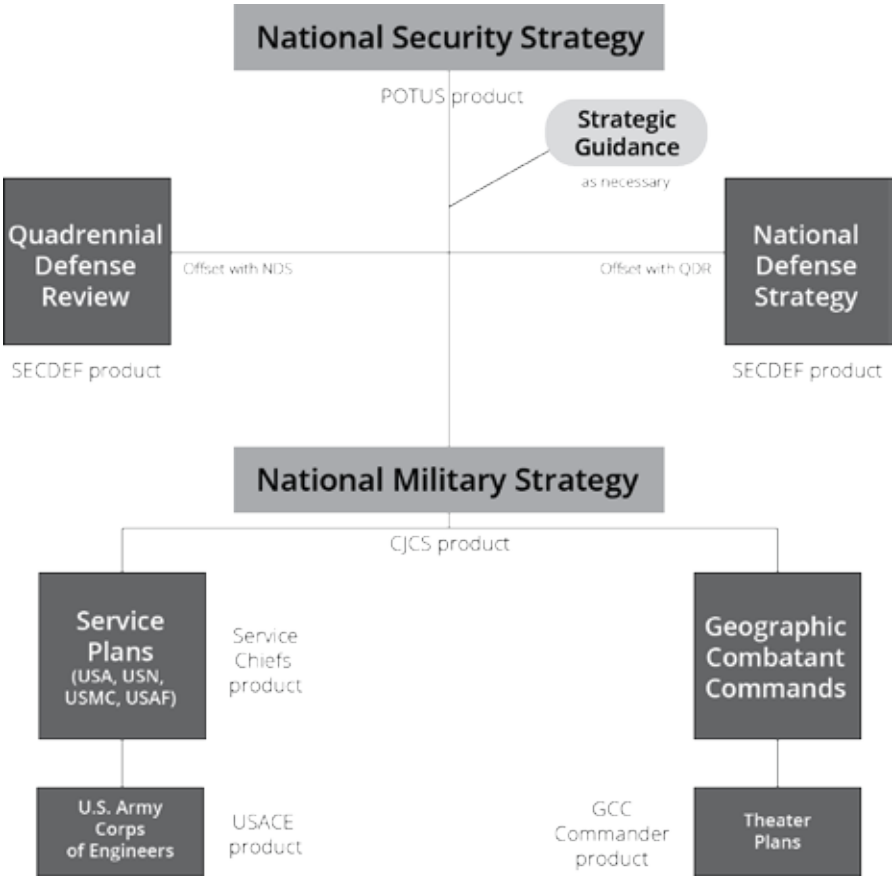
ation in its planning and operations. Such cognitive dissonance is likely caused by a conflation of notions about the Republican Party's leadership, most of whom deny climate change outright or human activity as the cause and, at the same time, advocate for a strong national defense as well as a collective sense that the DOD itself remains a tradition-bound dinosaur, blind and unable to react to real-world realities.[1]

At the end of 2015, climate change as a topic for policy received international attention because of the 2015 United Nations Climate Change Conference (COP21) in Paris on 30 November–12 December. In advance of that meeting, U.S. Secretary of State John F. Kerry spoke about the relationship of national security and climate change with special attention to the military and DOD. Kerry referenced the partisan political obstacles of combining the concerns about climate change with the realities of guaranteeing national security, including attacks against himself and Charles T. "Chuck" Hagel, the secretary of defense (2013–15).[2] Yet, to be clear, while the American political debate rages around "cause and effect arguments" about climate change, the DOD has positions and policies about climate changes that are unrelated to causal agencies. As a matter of policy, the DOD accepts climate change as a reality affecting the present and future operating environment and accepts that American military forces must deal with its operational consequences. This article will outline the evolution of DOD climate change policy and will highlight the current state of DOD climate change planning.

The Evolution of Climate Change Policy in the DOD

It is important to understand the architecture of national security policy documents and the political process associated with defense policy before proceeding into the evolution of climate change policy in the DOD. The architecture can be described as being driven from the top down, with varied inputs from the Pentagon. It begins with the *National Security Strategy* (NSS), a document that comes out of the White House with input from the National Security Council as well as advice from the various cabinet agencies (figure 1).[3] The NSS is not exclusively focused on military topics, and it includes such foundations of national strength as the economy, public health, and education. It is important to consider that the NSS is a political product from the White House reflecting the partisan views of the incumbent executive. From this document, the Pentagon produces the *National Military Strategy* (NMS), which outlines the current and future operating environment and how the DOD will deal with it in terms of activities, acquisitions, and resource allocations.[4] External to these documents, but closely related, is the *Quadrennial Defense Review* (QDR), which is produced for Congress every four years.[5] The QDR seeks to rebalance the military and establish priorities for the coming years. Occasionally, the executive branch

Figure 1. Architecture of the *National Security Strategy*



Courtesy of the author, adapted by MCUP.

crafts important policy documents that are outside the formal architecture of strategic policy documents. Further, policy documents also exist at lower levels (e.g., individual Services and the theater level).

DOD Policy during Obama's First Administration

Other than a nod to the energy industry about zero-emissions clean coal and ethanol technologies, the idea of climate change was absent in Republican President George W. Bush's March 2006 NSS, and it is fair to say that the United States government had no policy regarding climate change under his administration.[6] Several senators working together across the aisle in 2007 called for a study on the topic, especially an examination of potential national security impacts, but little came of it in terms of national policy without the support of the commander in chief.[7] The election of Barack H. Obama in 2008 introduced seismic shifts in American foreign and domestic policies, which included a 180 degrees reversal of foreign and domestic policy regarding climate change and

global warming. The Obama administration's first NSS appeared in May 2010, more than a year after the president's inauguration, and it directly addressed climate change.[8] Climate change was explicitly noted as part of the strategic environment affecting American interests as was the need to engage global partners on the issue.[9] Obama's strategy document noted that the "danger from climate change is real, urgent, and severe" and went on to state that global warming would lead to natural disasters, land degradation, and refugee crises.[10] The strategy outlined domestic and foreign policy goals. Domestically, the Obama administration intended to reinvigorate the nuclear industry, increase renewable energy, invest in clean energy technology, and lower emissions in the range of 17 percent by 2020 and 80 percent by 2050. As a matter of foreign policy, the administration sought to implement the Copenhagen Agreement and to work toward global cooperation in reducing emissions.[11] It was an ambitious framework devised when the Democrats controlled Congress, and one pundit pointed to how President Obama "renewed the authority and appeal of American leadership on great global issues" that positioned him well on this topic at home as well as abroad in 2009.[12]

The DOD followed suit with its 2010 QDR, which placed climate change in the realm of reforming how DOD did business, and its authors included the section "Crafting a Strategic Approach to Climate Change and Energy."[13] In these pages, DOD officials presented climate change as a problem to be dealt with rather than a problem to be solved. It was an issue that, in effect, shaped the operating environment and affected the roles and missions of the American military. They noted that "climate change could have significant geopolitical impacts around the world, contributing to poverty, environmental degradation, and the further weakening of fragile governments. Climate change will not only contribute to food and water scarcity and increase the spread of disease, but may also spur or exacerbate mass migration," all of which might act as accelerants of instability and conflict.[14] In order to deal with these threats, the DOD saw the way forward as developing effective assessment tools and building environmental security cooperation. As a second nod to the administration, the DOD report recognized the need to reduce the impact of its own energy outputs and move toward more effective energy stewardship, collaboratively working toward making more environmentally friendly facilities and organizations.

A year later, the NMS moved the DOD discourse in a different direction and tied the problem of climate change to how it might impact global demographics.[15] Noting that increasing demographic trends in the developing world affected the strategic environment, Admiral Michael G. Mullen, the chairman of the Joint Chiefs of Staff (JCS), advanced the idea that "the uncertain im-

pact of global climate change combined with increased population centers in or near coastal environments may challenge the ability of weak or developing states to respond to natural disasters."[16] In a nutshell, the JCS argued that a billion new urban dwellers living in underdeveloped littoral areas might be affected by climate change. Beyond this statement of strategic risk, the JCS left climate change alone.

Further strategic guidance from the Obama administration appeared in January 2012, conspicuously announcing a shift in focus to the Pacific.[17] This document established priorities for American force structure and the missions that the military would then undertake. While climate change was not specifically mentioned, the guidance noted that humanitarian and disaster relief operations were likely. This operational guidance, however, was circumscribed by noting that increasing or maintaining capacity to conduct such missions was not a priority requirement in building the future joint force.[18]

In analyzing the DOD's approach to climate change from 2006 to 2012, it is clear that the subject was introduced into American strategic policy as the administration shifted politically from the Right to the Left in 2009. Thereafter, as a matter of strategic concern, the DOD shifted its approach to climate change from a position of no action to one that accepted the reality of global warming and climate change, as these affected the strategic environment. Importantly, the DOD steered well clear of the issue of causation linked to human activity, preferring instead to address the agency's need for energy efficiency and economy. During the first four years of the Obama administration, the DOD came to the conclusion that climate change was most strategically relevant in the context of demographics; in this particular instance, how the impact of climate change might affect approximately one billion people who live in coastal or littoral areas of underdeveloped countries, which in turn creates risk and an obligation for humanitarian and disaster relief operations. Strategic guidance noted, however, that the joint force might not have the capacity to fully conduct such missions.

DOD Climate Change Policy, 2012–14

The reelection of President Obama ensured that the issue of climate change remained embedded in DOD policy. The administration reengaged the topic in the 2014 QDR and continued the trend toward making policy statements that acknowledged climate change and presented it as a significant challenge to DOD operations. Importantly, the 2014 QDR noted that "as greenhouse gas emissions increase, sea levels are rising, average global temperatures are increasing, and severe weather patterns are accelerating."[19] In turn these phenomena, coupled with global dynamics such as population changes "will devastate home,

Executive Orders

EO 13514
5 October 2009
Federal Leadership in Environmental, Energy, and Economic Performance

The first general, major directive by President Obama about the relationship between the U.S. government and climate change, EO 13514 focused on reduction and sustainability in the federal government. It required various agencies to reduce greenhouse gases by setting goals for reduction efforts (e.g., petroleum and water usage and waste management). It also set expectations for sustainability, especially in future contracts. This EO was revoked by EO 13693, *Planning for Federal Sustainability in the Next Decade*, signed on 19 March 2015.

EO 13653
1 November 2013
Preparing the United States for the Impacts of Climate Change

In response to President Obama's 2013 Climate Action Plan, this EO put a new focus on federal climate change adaptation and resilience efforts by requiring all agencies, including the DOD, to develop climate change adaptation plans. Agencies were required to identify their climate change-related risks to missions and operations and to describe their plans to address those risks. The EO also created a new federal organizational structure to coordinate climate change adaptation and resilience activities, including establishing a Council on Climate Preparedness and Resilience that consisted of high-level officials from federal departments and agencies.

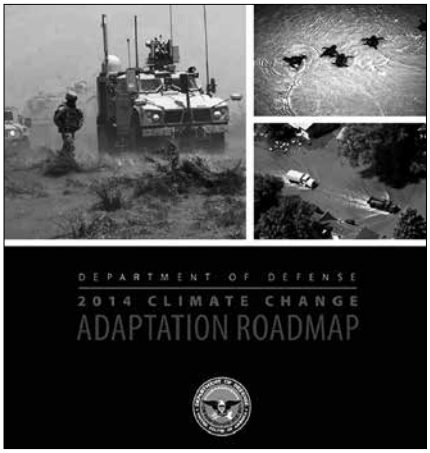
EO 13693
19 March 2015
Planning for Federal Sustainability in the Next Decade

This EO requires agencies to set more robust targets on a set of sustainability practices, including greenhouse gas emissions reductions, energy efficiency, and waste reduction and recycling for federal facilities. As the nation's single largest energy user, the federal government can serve both as an example and an agent of change, per the White House. The reduction of energy use mandated is effective starting the 2016 fiscal year. EO 13693 also revoked both EO 13423 and 13514 as well as several presidential memorandums.

land, and infrastructure." According to the QDR, the DOD needed to be aware of such issues as water scarcity, food shortages, and resource competition because they are "threat multipliers that will aggravate abroad such as poverty, environmental degradation, political instability, and social tensions—conditions that enable terrorist activity and other forms of violence."[20] Accompanying this bleak assessment, the DOD followed with a corollary about adaptation and innovation: "Climate change also creates both a need and an opportunity for nations to work together, which the department will seize through a range of initiatives."[21] Such initiatives included maintaining technological superiority and investing in energy efficiency, new technologies, and renewable energy sources.

In 2013, the administration initiated a review of existing policies, directives, and guidance regarding climate change that resulted in President Obama issuing Executive Order 13653, *Preparing the United States for the Impacts of Climate Change*, signed on 1 November 2013. This order affirmed and established a federal policy framework for addressing climate change and required an update to federal agency climate change adaptation plans within 120 days. There are three key concepts that guide the development and the operationalization of the climate adaptation plans: (1) mitigate climate change by cutting carbon pollution to avoid unmanageable consequences, (2) adapt

by preparing for climate change to avoid unmanageable consequences, and (3) lead international efforts to combat climate change and prepare for its global impacts. The executive order also established an interagency Council on Climate Preparedness and Resilience.



In turn, the DOD published its *2014 Climate Change Adaptation Roadmap*.[22] In his foreword to the roadmap, Secretary of Defense Chuck Hagel referred to the defense strategy noting once again that the DOD accepted climate change as a "threat multiplier" and also acknowledged that, although the science was converging on a consensus, DOD leaders remained uncertain.[23] The roadmap noted that climate change posed an *immediate risk* to U.S. national security and presented two DOD responses—adaptation and mitigation—as recommended by the administration. The authors defined adaptation as efforts to plan for the changes that are occurring or expected to occur and mitigation as efforts that reduce greenhouse emissions.[24] The DOD roadmap established three goals: (1) identify and assess the effects of climate change on the DOD, (2) integrate climate change considerations across the DOD and manage associated risks, and (3) collaborate with internal and external stakeholders on climate change challenges. The DOD now had a roadmap to integrate the expectations of the president and the commander in chief as laid out in Obama's EO 13653.[25]

The roadmap affirmed that climate-related effects were already being observed at DOD installations throughout the United States and overseas, which would affect decisions related to future operating environments, readiness, stationing, environmental compliance and stewardship, and infrastructure planning and maintenance. In terms of responsibility for coordinating these functions, the roadmap's authors reaffirmed the need for the DOD's Senior Sustainability Council, established in 2010, to direct strategy development and coordinate initiatives. In addition, a subordinate Climate Change Adaptation Working Group, established in December 2012, implements climate change requirements established by executive orders. The roadmap outlined the need for the department to examine and alter existing plans and operations, examine the effects of climate change on training and testing, assess the effects of climate change on DOD infrastructure, and assess the effects on weapon systems acquisitions. It also required planning for climate change effects to be pushed down to combatant commanders and installation commanders. Overall, the

2014 Climate Change Adaptation Roadmap may be characterized as a forcing document designed to generate self-assessment by the DOD to consider current and future capabilities and capacities.

Moving from the General to the Explicit, 2015

The Obama administration issued a revised NSS in February 2015, which prioritized eight efforts that addressed the top strategic risks to American interests for the first time.[26] Climate change ranked sixth of eight efforts, falling below catastrophic attacks on the homeland, threats or attacks against U.S. citizens, global economic crisis or slowdown, proliferation or use of weapons of mass destruction, and severe global infectious disease outbreaks, yet placed above major energy market disruptions and significant security consequences associated with weak or failing states. As a matter of national security policy, for example, efforts to adapt or mitigate climate change should rank below a global epidemic but above a refugee crisis. In effect, this reinforced the priorities established by President Obama's strategic guidance of 2012 in a more specific way.

In terms of explicitly explaining how climate change affects security, the authors of the 2015 NSS used the imperative "confront climate change" as one of eight areas vital to maintaining American security.[27] While the semantics of an imperative may seem inconsequential, this phrase moved the discourse from passive acceptance to active policy making in that officials in 2010 only noted that climate was a danger but, by 2014, noting that Americans must confront and deal effectively with the problem of climate change. Moreover, by establishing a priority of efforts addressing top strategic risks, the administration established a baseline for thinking about resources that should be committed to adapting to and mitigating the effects of climate change.

To summarize the administration's position and findings from several recent federal reports, the White House released *The National Security Implications of a Changing Climate* in May 2015. Much of the substance for this document originated in the *Third National Climate Assessment* published by the U.S. Global Change Research Program in 2014 but the authors also drew from the 2014 QDR, the 2015 NSS, and the 2014 *Quadrennial Homeland Security Review*.[28] The White House noted three explicit security implications.[29] First, there is a domestic threat to coastal areas; specifically, that "critical infrastructure, major military installations, and hurricane evacuation routes are increasingly vulnerable to impacts, such as higher sea levels, storm surges, and flooding exacerbated by climate change."[30] It is important to note that the threat to critical infrastructure does not mean vacation homes and boardwalks, but rather the temporary and permanent flooding of airports, ports and harbors, rail lines, tunnels, and bridges. Second, restating the earlier DOD position, climate change presents a

global risk as a threat multiplier, which accelerates social and political instability. The devastation of homes and infrastructure as well as worse refugee flows were noted. Third, climate change would increase the demands on military resources held by DOD. In addition to forcing the mitigation of risks to DOD installations and organizations, climate change was anticipated to increase demand for humanitarian and disaster relief overseas; produce a greater need for air, sea, and land capacity in the Arctic; limit operating environments for military operations; and create international instability.

The release of *The National Security Implications of a Changing Climate* created a flurry of interest in the Republican-controlled House and the United States Senate. Consequently, members of Congress submitted a request with the DOD 2015 appropriations bill asking the DOD to identify the most serious and likely climate-related security risk of each geographic combatant command (GCC); the ways in which the GCCs integrated mitigation of these risks into their planning processes (including providing humanitarian assistance and disaster relief [HADR], engaging security cooperation, building partner capacity, and sharing best practices in mitigation), and a description of the resources required for an effective response. Responding quickly to the request, DOD officials released a *Response to Congressional Inquiry on National Security Implications of Climate-Related Risks and a Changing Climate* on 23 July 2015.[31] To answer the congressional queries, the report was organized in three sections: part I "Common Conceptions of Risk and Response," part II "GCC—Specific Aspects," and part III "Conclusion."

The report began by clearly restating both the security-related risks posed by climate change as well as the DOD's possible responses in terms of military missions. In part I, the DOD noted that it "recognizes the reality of climate change and the significant risk it poses to U.S. interests globally."[32] Further, "climate change is an urgent and growing threat to our national security." The response also affirmed that the DOD *Climate Change Adaptation Roadmap* represented a serious recognition and attempt to deal with the threats. In addition to the general thrust of the DOD's views on climate change dangers and risks, the GCCs identified four principal climate-related security risks.

First, persistently recurring conditions such as flooding, drought, and higher temperatures cause a strain on fragile states and vulnerable populations. This risk also affects changes in patterns of infectious diseases. Increased intrastate and interstate migration is seen as a signature of this, requiring the DOD to increase humanitarian assistance and aid. Second, more frequent or more severe extreme weather events require more substantial involvement of DOD units, personnel, and assets in HADR. Third, rising sea levels and temperature changes lead to a greater chance of flooding in coastal areas, adverse impacts

on navigation, damage to port facilities, and displaced populations. This risk requires greater DOD participation in HADR and security cooperation. Finally, the decreasing Arctic ice cover, type, and thickness leads to increased tourism, greater resource extraction, and greater thawing permafrost. In turn, this greater access may increase the need for more search and rescue (SAR) capabilities.

While some might assume that DOD officials are just going through the motions in terms of implementing climate change policies, the stipulations for adaptation, and even mitigation, are leading to extensive changes in the department that trickle down into the activities of various U.S. military branches worldwide. According to the DOD, "all of the GCCs use their Theater Campaign Plans, Operations Plans, Contingency Plans, and Theater Security Cooperation Plans as a means to identify or take into account climate risks."[33] Although activities vary, the combatant commanders work with their global partners to build infrastructure such as disaster response warehouses and shelters, training, best practices for mitigation of installation vulnerabilities in order to provide disaster management and response (in coordination with USAID), and equipping partners and nongovernmental organizations (NGOs) to improve capability and capacity. The GCCs are also sharing with partners across the globe. DOD officials, as a part of this national security report, noted that resources for assessing and responding to climate change impacts are currently provided within existing DOD missions, funds, and capabilities, and the main source of funding for the GCC's HADR comes from the Overseas Humanitarian, Disaster, and Civic Aid appropriation.

It is clear from part II of the report, "GCCs—Specific Aspects," that the GCC staff members take climate change seriously, and that they regard climate change as having the greatest impact on areas already prone to instability. The GCC staffs also recognize the risk that climate change poses to existing resource allocation. As such, it is fair to say that the GCCs are moving toward an explicit narrative and understanding of the impact of climate change.

Specific Aspects of Risk and Mitigation

The DOD, working with its various commands, has identified a number of risks specific to the area of responsibility (AOR) under the purview of each GCC. The following summaries illustrate these specific risks.[34]

U.S. Africa Command

The authors of the national security report point to humanitarian crisis as the greatest concern for the commanders of the U.S. Africa Command (USAFRICOM). They have assessed humanitarian crisis as the most likely climate-related risk within its AOR, foremost due to the impact that devastating events, such as drought and disease, could have on vulnerable populations

and on state stability in places already struggling with fragility and conflict. USAFRICOM assesses that climate change will exacerbate existing economic, social, and environmental vulnerabilities, while conditions of drought, disease, and economic stagnation may tip states toward systemic breakdowns. Since at least 2007, the USAFRICOM commander has been arguing for a more holistic approach to creating security and stability in Africa, one that includes environmental concerns.[35] As of the 2015 report, USAFRICOM highlights how climate change will alter the distribution and quality of natural resources, such as fresh water, arable land, coastal territory, and marine resources. Scholars speaking and writing on contemporary Africa confirm that the country's stability, or lack thereof, hinges on several significant factors, climate change being one of them. More recently, USAFRICOM's Jeff Andrews brought the perspective of the command's Environmental Security Office to public discussion about the challenges of natural disasters and "unconventional approaches to building security" on the continent.[36]

U.S. Central Command

U.S. Central Command (USCENTCOM) similarly monitors resource scarcity (e.g., water, food, and energy) in its arid AOR and accounts for this factor in its planning for operations in the twenty countries that make up what is commonly referred to as the Middle East, including areas of recent conflicts, such as Afghanistan, Iraq, and Syria. USCENTCOM identifies that climate changes heighten competition at the national or subnational level in an already arid region, and this competition could be more dangerous as actors seek to protect limited resources. Interstate conflict risk, however, is generally attenuated by the context of international treaties and agreements.[37]

U.S. European Command

U.S. European Command (USEUCOM) is concerned with security risks arising from increased shipping, military operations, and resource exploration in the Arctic as the ice cap melts. The commanders in USEUCOM work with the North Atlantic Treaty Organization (NATO) and partner nations in the European Union (EU), which dictates a different set of relationships compared with commands in politically and unstable AORs, such as Africa, or in developing countries. National leaders in the EU have been front and center in global efforts to mitigate climate change and embrace the topic as seen in the 2015 Paris meetings.[38]

U.S. Northern Command

The North American Aerospace Defense Command/U.S. Northern Command (NORAD/USNORTHCOM) commanders are concerned with the same risks

as USEUCOM leaders and identify increased resource exploration in the Arctic as driving an increase in the future demand for SAR and environmental disaster response missions in support of other agencies and civil authorities. Since this GCC is focused on homeland security and has few permanent forces, it can provide support but not drive too much effort. The United States, which is the main AOR for this command, has local and state forces that constrain national activity due to the federal system of authority.

U.S. Pacific Command

U.S. Pacific Command (USPACOM) considers rising sea levels to be a particularly significant threat to people in geographically vulnerable locations. Additionally, USPACOM anticipates severe weather-related impacts, in addition to humanitarian assistance in its AOR, will increase the demand for Defense Security Cooperation Agreements as well as pose a challenge to U.S. critical defense infrastructure. In April 2013, PACOM's commander, Admiral Samuel J. Locklear III, testified to the Senate Armed Services Committee describing the problems of growing numbers of people living along the littoral regions of his AOR combined with natural disasters, including some related to climate change. He noted the complex relationship of economy, demographics, and climate change when he said, "the trend is increasing as people move towards the economic centers which are near the ports and facilities that support globalization."[39] He expected at the time that as the migration trend continued, USPACOM and various agencies would have to be prepared. The issues that USPACOM will be facing will be addressed inside and outside of the command. Locklear recently joined The Center for Climate and Security, bringing with him an insider view of the U.S. Navy and the Pacific AOR as well as any weaknesses that may have been evident in government planning.[40]

U.S. Southern Command

U.S. Southern Command (USSOUTHCOM) similarly highlights the threat that sea level rise, ocean acidification, and water warming pose to fish stocks, coral, mangroves, recreation and tourism, and the control of disease. USSOUTHCOM also identifies coastal flooding to be a particular concern for parts of the Caribbean basin due to climate change-related sea level rise. Moreover, the Oak Ridge National Laboratory has been doing assessments for the various commands, updating the USSOUTHCOM statistics and variables recently. The projected warmer temperatures, no matter what the cause or other debated aspects of global warmer, will result in more heat waves and thus an increased chance of wildfires, flooding, and drought. In addition to compromising food production in Latin America, these natural disasters could have

an impact on the issues already identified by USSOUTHCOM in the July 2015 report to Congress about national security.[41]

Mitigation Efforts

The GCCs have integrated climate-related risk mitigation into their planning processes. While the impact of climate change varies by theater and the conduct of GCC climate-related activities vary, "all GCCs share a common assessment of its significance."[42] Some examples are as follows:[43]

- USAFRICOM has included climate-related factors into its theater campaign plan (TCP) and expanded its HADR country plans. It works closely with USAID and works to build partner capacity and has engaged with embassy country teams to ensure DOD contributions to embassies' integrated country strategy documents.
- USCENTCOM is focusing on nearer-term (five years) projected changes in climate. It has factored current and historic climatic conditions into its TCP, especially in regard to water scarcity. It has included warning indicators as a part of the deliberate planning process. HADR and security cooperation are identified as lines of effort (LOE).
- USEUCOM has created an Arctic security roundtable and has sponsored a table-top exercise, Arctic Zephyr, focused on Arctic SAR operations.
- USNORTHCOM has developed planning tools and routinely includes extreme weather-driven scenarios in training events and exercises. It is partnering with other federal agencies to prepare for catastrophic climatic events and working with partners to improve acquisition and supply chain requirements for the Arctic.
- USPACOM has created an "all Hazards" LOE in its TCP to improve both response readiness and sustainable resource management. Country security cooperation plans have been updated with host nation collaboration through a variety of operations and activities. It is developing a visual display tool that provides historic event days, climate and weather data, and population demographics. USPACOM is aggressively working with allies and partners to leverage lessons learned and best practices in order to maximize limited resources. It has established augmentation teams around the AOR to quickly identify immediate needs.
- USSOUTHCOM does not explicitly incorporate climate change planning; it maintains communications with regional partners regarding disaster response and humanitarian assistance. It provides support as

needed for natural disasters and conducts security cooperation activities related to adapting to climate changes. It has identified the additional resources needed to achieve the goals set forth in the DOD roadmap.

Climate Change Policy within the Military and Naval Departments

With the exception of the United States Army Corps of Engineers (USACE), it is difficult to find specific climate change policies from the three DOD departments—Army, Navy, and Air Force. It is fair to say that the Services, at least at this time, are focused primarily on the protection of bases and infrastructure and secondarily on the development of sustainable and renewable energy sources. These are essentially near-term, and one might say tactical, approaches that reflect the resources and capabilities of the departments themselves. For a strategic approach, one must look to the USACE for a more nuanced and tangible long-term policy and plan.

The USACE *Climate Change Adaptation Plan* published on 27 June 2014 included an "Adaptation Policy Statement" signed by Jo-Ellen Darcy, assistant secretary of the Army for Civil Works.[44] The policy was prepared under the direction of the USACE Committee on Climate Preparedness and Resilience and was in part an institutional response to the president's EO 13653. The resulting USACE climate change policy statement is breathtaking in the challenge that the organization self-imposes "that mitigation and adaptation investments and responses to climate change shall be considered together to avoid situations where near-term mitigation measures might be implemented that would be overcome by longer-term climate impacts requiring adaptation, or where a short-term mitigation action would preclude a longer-term adaptation action."[45] Such an ambitious policy depends on an articulate strategy and an institution intellectually and physically disposed to take action.

The USACE positions itself as the nation's "largest and oldest manager of water resources" and thus a key player in environmental-based national security considerations. The climate change policy for the USACE is explicitly defined as "mainstreaming" adaptation and mitigation into the agency's water resources projects, including civil works programs and water resources infrastructure. The USACE's plans are unique in that they identify developing six core priorities to reduce the vulnerability of the nation's waterways, ports, and associated infrastructure and habitation. These core priorities are infrastructure resilience, vulnerability assessments, risk-informed decision making for climate change, nonstationarity, portfolio of approaches, and metrics and endpoints.[46] In essence, the USACE advances an interagency approach to gather, understand, and analyze climate and hydrologic data and then use it to make informed

decisions regarding resource management, risk, and opportunity. Importantly, the USACE is emerging as a leader in engaging with international organizations such as the World Bank, NATO, and the World Association for Waterborne Transport Infrastructure as well as U.S. government agencies such as the GCCs to find collaborative solutions for adaptation, mitigation, and sustainability.[47] Since the 2014 report was published, the USACE forward thinking, multi-agency approach has continued to be advanced. Swathi Veeravalli, a USACE research scientist, noted that interagency and NGO collaboration will be needed to secure stability in places such as Africa where climate change "presents complex challenges for the fields of defense, diplomacy, and development."[48]

Whither Goest DOD Climate Change Policy?

Under President Obama, the DOD has moved from a national security position that ignored climate change as a defined risk to fully embracing climate change as a real and present risk. Within the Obama years, national security policy as articulated by the NMS, NSS, QDR, and strategic guidance directives from the White House has moved the narrative about climate change and national security from generalizations to explicit understandings about risk, adaptation, and mitigation. Further, the DOD has articulated a defined roadmap outlining how it will approach climate change adaptation and mitigation and tasked its subordinate GCCs to explicitly assess how climate change will impact their AORs and the populations living within them.

It is fair to say that from 2009 to 2012 military planners regarded climate change as relevant to the DOD mostly in the context of demographics. National security policies rested on the principal that climate change would have an impact on populations and primarily increase instability along the coastal and littoral areas, particularly affecting weak states. The DOD, in turn, would have to react to crises and events in these areas. A more comprehensive approach toward climate change and the risks associated with it evolved in President Obama's second term, and by 2014, such matters as critical infrastructure and considerations of the impact on the Arctic appeared in policy documents. The *Climate Change Adaptation Roadmap* was a bellwether shift for the DOD as the White House demanded a harder look at assessing the actual impact of climate change on the operations and activities of the GCCs. By 2015, the DOD and its subordinate GCCs were able to explicitly articulate the ramification of climate change events in their AORs and how they intended to plan for them.

Climate change remains a hotly contested and divisive issue in the Democratic and Republican Party platforms as the election of 2016 approaches, even when these issues do not reach the level of media attention. Republican candidates seeking their party's nominations have promised to reverse many of the Obama administration's executive orders, among them are those addressing

climate change. At this point, climate change policy in the DOD already seems deeply embedded in both national- and theater-level planning. Whether climate change adaptation and mitigation might be deconstructed and taken out of American national security matters after January 2017 remains to be seen. Regardless of whether the high-level policy decisions resolve themselves, there is absolutely no question that the DOD will have to deal with the real-world consequences of climate change, man-made or otherwise, that have been seen in recent years. Instability driven by natural disasters, migration, and water and food scarcity will surely continue into the future, and American servicemembers will find themselves at the intersection of politics and actual events.

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Richard Nixon, Barack Obama, and the Road to American Climate Change Policy

J. Brooks Flippen

Abstract: Lying at the intersection of public opinion, science, and partisan politics, the debate over climate change has grown with each successive president from Richard M. Nixon to Barack H. Obama. This article argues that these two presidents, from different parties, in different eras, and with different motivations, did the most to advance federal policy. Nixon's actions laid the foundation for Obama's activism, defining the realm of possible. In a similar sense, Obama has also set the parameters of the debate for his own successors, whomever they may be.

Keywords: global warming, climate change, Richard Nixon, Barack Obama, cap-and-trade, carbon emissions, clean air act

In mid-September 1969, President Richard M. Nixon's top domestic advisor, John D. Ehrlichman, received an urgent memo from Daniel Patrick Moynihan, the new White House counsel. Moynihan, an intellectual with a doctorate from Syracuse University and a long record in Democratic Party politics, had come to appreciate Nixon's recent embrace of environmental activism and now insisted that he had an issue that demanded the president's immediate attention. "Carbon dioxide in the atmosphere has the effect of a pane of glass in a greenhouse," Moynihan explained to Ehrlichman. The burning of fossil fuels

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could raise atmospheric CO_2, which in turn could raise global temperatures. "Over the years the hypothesis has been refined," Moynihan added, "and more evidence has come along to support it." At the time, it seemed that if the process continued, sea levels could rise with devastating effects: "Goodbye New York. Goodbye Washington, for that matter." Moynihan acknowledged reservations, "It is entirely possible that there will be countervailing effects." For one, "an increase of dust . . . would tend to lower temperatures." Moreover, it was "possible to conceive fairly mammoth man-made efforts to countervail the CO_2 rise." In any event, it was a subject "that the administration ought to get involved with." It was a "natural" for the North Atlantic Treaty Organization and the administration should act quickly.[1]

Just more than 43 years later, on 12 February 2013, President Barack H. Obama stood before Congress for his first State of the Union Address since his reelection. He had raised the topic of climate change in his 2010 and 2012 addresses, but this time he was more explicit and obviously exasperated. A Republican Congress had blocked many of his initiatives and Obama wanted to impart a sense of urgency. "For the sake of our children and our future, we must do more to combat climate change," Obama declared. "Heat waves, droughts, wildfires, floods—all are now more frequent and more intense." Americans could "choose to believe" that it all was "just a freak coincidence" or they could accept "the overwhelming judgment of science and act before it's too late." There was no more time to wait. "If Congress won't act soon to protect future generations," Obama concluded, "I will." He was directing his cabinet to "come up with executive actions we can take, now and in the future."[2]

For almost half a century, from the arrival of the issue in presidential politics during the Nixon administration until its dominant place in the national discourse during the Obama presidency, global climate change has sparked controversy and discord. Progress has been real, but slow and halting. Lying at the intersection of public opinion, science, and partisan politics, the debate over climate change has grown with each successive presidency. The activist agenda of the Obama administration, both its successes and failures, had antecedents. In fact, America's record in facing the threat of climate change is unique and surprising. Two presidents—Nixon and Obama, from different generations, different parties, and with different motivations, one at the dawn of environmentalism and the other still struggling to maintain its momentum today—proved to have the strongest records in addressing the issue. In many respects, Nixon laid the foundation for Obama's activism, his presidency defining the realm of possible for his successor. Obama has done the same, setting the table for whoever follows. The future is uncertain but the strong legacies of this presidential odd couple are not.

Moynihan was correct that, by the late 1960s, many scientists had begun to

conclude that, yes, CO_2 released by the burning of fossil fuels did in fact contribute to the greenhouse effect. It had been almost 75 years since the Swedish scientist Svante A. Arrhenius had proposed that a relationship existed between atmospheric CO_2 concentrations and global temperatures.[3] By the 1930s, scientists had documented that the North Atlantic region had warmed considerably over the previous half century, and by the 1950s, funding for science as part of the Cold War had provided more accurate assessment measures. By the late 1950s, scientist Charles D. Keeling had begun to produce the first concentration curbs for atmospheric CO_2, which proved iconic in the science of global warming. With the United States dispatching its first meteorological satellite in April 1960, the United Nations in 1962 called for organization of the scientific community to advance atmospheric and climate science. By 1965, a Global Atmospheric Research Program existed and a Joint Organizing Committee of leading international scientists promised significant advances due to new computer modeling. By 1968, some models had even projected the possibility that collapsing Antarctic ice sheets would raise sea levels catastrophically.[4]

The early results of such a study caught Moynihan's eye. They did not, however, convince his colleagues. Hubert Heffner, deputy director of Nixon's Office of Science and Technology Policy, acknowledged that the administration should take note but expressed reservations. "The more I get into this, the more I find two classes of doom-sayers, with, of course, the silent majority in between," he responded. Heffner worried that "One group says we will turn into snow-tripping mastodons because of atmospheric dust and the other says that we will have to grow gills to survive the increased ocean level due to temperature rise."[5] If Moynihan's concerns proved farsighted, Heffner's reservations were understandable. There remained, of course, considerable scientific doubt. Ocean sediment research showed that there had been more than 30 cold-warming cycles in the last 2.5 million years, and some scientists cited stable or downward trends in global annual temperatures. Smog, some suggested, would contribute to a new ice age, not global warming.

It was a question of science—but it was also a matter of politics. The science was questionable, Nixon understood, but the politics appeared less so. Just one month before Moynihan wrote his memo, astronauts had walked on the moon and projected images of Earth, as a fragile whole, back to rapt audiences. Rachel Carson's seminal bestseller *Silent Spring* remained on the bestseller lists and workers remained hard at work cleaning up a large oil spill at Santa Barbara on California's pristine coast.[6] Polls reflected exploding public sentiment for environmental protection. It was more than the wise-use conservation of the Progressive Era but the realization that modern life threatened world ecology.[7] Air and water pollution, overpopulation, pesticides, and a myriad of other issues appeared related in the minds of a new majority of Americans. And Nixon

saw political advantage. Early environmental protections enacted during the presidencies of John F. Kennedy and Lyndon B. Johnson had won strong environmental support, but a growing number of Democrats, led in part by Maine Senator Edmund S. Muskie, appeared committed to pushing a new wave of antipollution legislation. The Republicans had an impressive record extending back to Theodore Roosevelt, Nixon understood, but he was not about to let Congress and the Democrats gain the upper hand. Given that the new environmentalists tended to oppose his ongoing Vietnam War, the better his advocacy was. In short, Moynihan's memo arrived at the perfect time to win presidential support, even if the president then cared more about votes than endangered species. Climate change was simply part of a bigger issue, an issue that both parties hoped to advance.

Forty years later, President Obama certainly understood. The debate over climate change still unfolded under the umbrella of environmental politics, still remained a partisan competition with Congress, and still revolved around science. The science and the political competition had changed, of course, but the template was set. Nixon quickly established a new federal bureaucracy that would prove critical to Obama's efforts. Throughout the Obama years, the Council on Environmental Quality (CEQ), created by the National Environmental Policy Act (NEPA) that Nixon had signed, strongly endorsed addressing climate change. In fact, in its first annual report in 1970, as if to follow Moynihan's memo, CEQ had devoted an entire chapter to the possibility of CO_2-based global warming. This had so impressed Delaware Senator J. Caleb Boggs that he had the entire chapter entered into the *Congressional Record*. Thirty-seven years later, in its last annual report before congressional Republicans eliminated the reporting requirement, CEQ still devoted an entire chapter to the global environment and climate change.[8] Meanwhile, NEPA officially made it American policy to protect environmental quality, a statutory obligation that clearly empowered Obama's agenda. In fact, NEPA included provisions for required environmental impact statements, a mandate that environmentalists would continue to employ to block questionable fossil fuel operations during the Obama years. The Environmental Protection Agency (EPA), created by Nixon, would, of course, assume a leading role in combating climate change during Obama's presidency. Perhaps more obvious, the research of the Nixon-era National Oceanic and Atmospheric Administration (NOAA) would continue to produce data invaluable in the ongoing scientific debate.

Obama genuinely cared about climate change, no doubt because of the work of Nixon-era scientists. As Nixon wrestled with Watergate, the Global Atmospheric Research Program launched with strong American support its Atlantic Tropical Experiment, the largest climate change operation to date, involving geostationary satellites, a dozen well-instrumented aircraft, and more

than 20 ships to support a network of ocean stations. The project, a study that if carried out would have explained the infamous El Niño phenomenon much earlier, had originally been planned for the tropical Pacific, but it did eventually produce data that swayed a growing majority of climate scientists that global warming was real. At the same time, the Joint Organizing Committee began planning its first truly global experiment—a massive project whose planning extended from the Nixon years into the presidency of James E. "Jimmy" Carter and which collected data until the 1980s. The research proved critical in, again, swaying the scientific community to consensus.[9]

If the Nixon years helped lay the foundational science that would sway Obama, Nixon's dynamic political calculations had ripples years later as well. Nixon's early agenda to win the new environmental vote produced stronger air and water pollution legislation, new regulations for pesticides, new protections for endangered species and ocean mammals, and new land management policies, among other accomplishments that remain cornerstones of environmental law and policies today. Among Nixon's initiatives with direct implications for climate change were proposals to have the Department of the Interior better regulate surface mining for environmental damage and a temporary moratorium on new coal leasing, provisions the coal industry fought. This impressive record may have stood the test of time, but it did not translate into more votes as Nixon had hoped. As his first term neared its end, Nixon began to surmise that he could never win the environmental vote. The Democrats would always promise more. As Nixon succinctly put it, "You can't out-muskie Muskie."[10] Moreover, the administration's new regulations were angering his natural business constituency. Voters, Nixon now concluded, would vote their pocketbooks. The environmental vote was wide but not deep. Accordingly, Nixon's second term witnessed an astounding political shift, a withdrawal from environmental advocacy that would anger environmentalists and embolden their opponents.

The Arab oil embargo following the Yom Kippur War in 1973 quickened Nixon's environmental retreat. The nation needed oil, and while Nixon encouraged conservation, the thrust of his "Project Independence," unveiled in November 1973, was greater production of fossil fuels. The EPA faced budget cuts. Administration support for the Alaskan oil pipeline grew, and the White House soon joined with the coal industry to weaken the regulatory provisions it had earlier proposed. Nixon demanded new drilling on the outer continental shelf and of oil shale deposits and signed the Energy Petroleum Allocation Act of 1973, which sought to stimulate domestic oil production by raising the controlled price of a barrel by one dollar. Increasingly, Republicans argued that environmental regulations hampered economic growth. The two objectives were mutually exclusive, the GOP implied, encouraged by the powerful oil interests. A growing number of Democratic congressmen complained about

the administration's new stance, and many environmental groups were more explicit, endorsing those who did. In short, by the end of the Nixon years, it was becoming obvious that environmental protection was a Democratic issue more than a Republican one. Increasingly, partisanship defined all environmental issues.[11]

Obama could certainly understand. Assuming office in 2009, he operated within a milieu in which the environment had devolved almost into a litmus test for partisan affiliation. The shift that had begun during Nixon's second term had culminated in the early twenty-first century. "We know that global climate change is one of the biggest threats of this generation—an economic, environmental, and national security catastrophe in the making," the 2012 Democratic platform read. The party "affirm[ed] the science of climate change" and committed to "reducing the pollution that causes [it]."[12] The Republicans were quite the contrast. Their 2012 platform spoke of "tapped and untapped" natural energy resources, the development of which "must be the role of public officials." The platform spoke of new oil and coal initiatives and supported the controversial Keystone XL oil pipeline from Canada. It spoke of the EPA's "war on coal." It did not, however, even once mention climate change.[13]

This partisanship would vex the new Democratic president. As David B. Bancroft, president of the Council on Environmental Affairs, recalled, "Obama quickly found out that his administration was not going to get Republican congressional cooperation."[14] Three years prior, former Democratic Vice President Albert A. "Al" Gore, a partisan lightning rod, had produced the Academy Award-winning documentary *An Inconvenient Truth* (2006), highlighting the role of carbon emissions in global warming. The film was, many Republicans believed, pure demagoguery, an unfair assault on America's energy-based economy. In 2014, the fact-checking website of the *Tampa Bay Times*, Politifact, found that only 8 of the 278 congressmen in the Republican caucus had made comments supporting the science of climate change. It had become common for Republicans to suggest that the science was still unsettled, noted Nobel Prize-winning economist and *New York Times* columnist Paul R. Krugman. "I am not a scientist" had become a safety valve for Republicans anxious to avoid the issue.[15] Of course, some in the GOP had grown more openly hostile. In 2005, Texas Congressman Joe L. Barton, who had chaired a number of energy and environmental related congressional committees, launched an investigation of scientific reports affirming climate change. It was a "witch-hunt," the *Washington Post* reported, citing the opinions of leading climate scientists.[16]

As Democrats in the Obama administration lamented what they called the "Republican war on science," many in the GOP gave them strong ammunition.[17] In 2015, Lamar S. Smith, another Texas congressman with strong connections to the oil industry, subpoenaed documents from a NOAA study

supporting climate change. It was an obvious attempt at intimidation; a group of more than 600 scientists wrote Kathryn D. Sullivan, head of the agency, urging her to stand up to the "bullying." NOAA scientists should have the clear "ability to pursue research and publish data and results regardless of how contentious the issue may be."[18] The partisan warfare, it was clear, had settled on the battlefield of science. Once the sole domain of academia and large corporations, their work in obscure labs and papers, scientists now found their conclusions and publications grist for the political mill, weapons for politicians.

While some scientists bemoaned their new role, arguing in many instances that lay people did not understand their complicated analysis or deliberately twisted their conclusions, this battlefield too had its roots in the Nixon administration. The first significant environmental fights over science took place more than 40 years before Congressman Smith and NOAA's Sullivan battled in front of the cameras. Early in 1969, Nixon still hoped to win the environmental vote, but supported development of the so-called supersonic transport, or SST, a plane that could move commercial passengers at speeds greater than the speed of sound. He worried that the Soviet Union and several European countries were developing their own planes and did not want the United States to fall behind. Many environmentalists, however, complained of the sonic boom—noise pollution they argued. To mollify them, Nixon decided to propose only one prototype, not a full fleet. Unfortunately for Nixon, however, this compromise hardly ended the controversy. Into the debate came scientists at the National Center for Atmospheric Research (NCAR). High-level supersonic flight, they theorized, eroded the world's ozone layer, a protective sheath in the atmosphere that reflected solar heat and thus mitigated warming. Not all scientists agreed with this hypothesis and the Department of Transportation began a four-year monitoring program, the Climate Impact Assessment Program, aimed specifically at the question of the SST. Meanwhile, the NCAR, a nongovernmental body but one heavily dependent upon public funds, found itself facing financial pressure. In the end, Congress blocked development of the SST largely because of the noise and cost concerns, but for the first time, scientists had apparently drawn the ire of politicians.[19]

In the larger sense, the success of the environmental movement during Nixon's first term embedded requirements and regulations into statutes whose legalese was often as complicated as the scientific jargon they cited. Simply put, the new laws and their implementation were open to interpretation. Whereas before protesters and grassroots activists had guided the environmental agenda, now lawyers with briefcases determined its outcome. When Nixon began to retreat in his second term, beginning the larger Republican metamorphosis, the oil and coal industry and a number of other business interests rushed to flush out ambiguities in the law or science. One good example with consider-

able implications for climate change was implementation of the Clean Air Act amendments of 1970, one of the crown jewels of Nixon's early environmentalism. The law provided tough federal regulation of any pollutants designated harmful to air quality and called for national ambient air quality standards and limits on specific pollutants, including three that related to auto emission standards: carbon monoxide, nitrogen dioxide, and hydrocarbons. While none of the three were global warming gases, all quickly became embroiled in scientific debate over whether the standards were technically possible. The debate raged throughout the remainder of Nixon's presidency and included discussions of delayed deadlines, exemptions, and new catalyst technology. The science soon entered the courtroom with auto company lawsuits.[20]

The law also, however, had implications more directly for climate change. It called for limits on sulfur dioxide, a pollutant, emitted as an acrid yellow gas from stationary sources, such as factories. In 1971, with Nixon still entertaining hopes of winning the environmental vote, the EPA proposed taxing sulfur dioxide as a way of reducing its harmful emissions. The coal industry protested and the energy crisis of the 1970s soon strengthened its hand. Nixon, feeling the pressure, retreated on his proposed tax and the tougher auto emission standards. Still, however, the scientific debate did not end. Not only was sulfur dioxide converted to sulfuric acid, contributing to the "acid rain" problem prominent in the 1990s, some scientists claimed that sulfur dioxide contributed to ice crystals in the upper atmosphere. When these crystals migrated upward into the stratosphere, they contributed to water vapor, which at that level constituted a greenhouse gas. Other scientists, however, quickly countered. In the atmosphere, they argued, sulfur dioxide was also transformed into sulfate aerosol, a fine particle that reflected solar radiation and also served as a condensation nuclei for cloud droplets, which served the same purpose. By the time of the Obama administration, scientists debated geoengineering, using sulfur dioxide to counter the climate change impact of CO_2. In sum, the scientific debate was complex, controversial, and politically significant during the Nixon years—a reality that still remained for Obama.[21]

President Obama found Nixon's Clean Air Act amendments of 1970 particularly helpful in advancing the fight against climate change, igniting another debate over the science of it all. When Obama first came into office in early 2009, he advocated a so-called cap-and-trade bill designed by Henry A. Waxman, Democratic representative from California, and Edward J. Markey, Democratic senator from Massachusetts.[22] Under the plan, the first one ever designed for a national assault on global warming, the government would set a limit, or a "cap," on the total amount of all greenhouse gases that could be emitted nationally, and the cap periodically lowered. Per the statute, the appropriate government agency would then sell "allowances" to emit such gases up to the

limit. Businesses could not emit more gases than they had allowances for, but could exchange them on an open market, or trade them, which would establish an economic incentive for reduction. Obama pushed the plan through the House, but Republicans blocked it in the Senate.[23] Largely frustrated in his efforts to combat climate change in a systemic way throughout his first term, and of course preoccupied with the recovery from the so-called Great Recession of 2008, Obama hit upon the Clean Air Act as a way to act unilaterally as his second term began, just as he warned in his 2013 State of the Union. Interpreting the law broadly and noting that it gave the EPA significant ability to define and regulate what constituted air pollutants, Obama announced that all greenhouse gases, all carbon emissions, constituted such a pollutant. As such, the EPA already had the authority to regulate them according to the Nixon-era law.[24]

Obama unveiled his plan with as much fanfare as Nixon had done announcing NEPA in 1970. In June 2013, Obama released an extensive climate action plan that called for cutting CO_2 and all greenhouse gases. It was a "moral obligation to future generations," Obama declared.[25] What followed were a series of executive orders, presidential memoranda, and EPA regulations covering every aspect of fossil fuel production, most notably establishing national limits for CO_2 sources from the nation's existing power plants. It established for each state individual emission reduction targets specific to its needs and circumstances, a provision that reflected the Clean Air Act's initial construction. It empowered local and state officials to plan for climate changes and it directed NOAA and the National Aeronautics and Space Administration to improve further climate data. The plan also called for reduced hydrofluorocarbon production, increased renewable energy source use, and more strictly regulated automotive emissions standards, among others. Reports on progress were mandatory.[26]

Without surprise, Republicans howled in protest, claiming that the science did not warrant the actions and that the president had grossly overstated his authority. Congress had not intended the Clean Air Act in such a way, they claimed, and promised litigation. Aware that the U.S. Supreme Court had earlier upheld broad interpretations of the law's provisions, Obama proceeded confidently.[27] As the 2016 presidential election approached, many Republicans in Congress pushed for pressure through the appropriations process. Nixon had battled Congress from the other side of the issue during his second term, but the partisan warfare was just as acrimonious.

Throughout it all, like Nixon, Obama used his presidential bully pulpit liberally. When Nixon, for example, selected 1 January 1970 to sign NEPA, he declared that it was "particularly fitting" to do so. The 1970s must, Nixon declared, "be the years when America pays its debt to the past by reclaiming the purity of its air, its water, and our living environment."[28] While never known

for his soaring rhetoric like Obama, Nixon nevertheless did his best to couch his initiatives as lofty, moral imperatives. Indeed, throughout his first-term environmental offensive, Nixon took every opportunity to couch the environment as a critical issue and the president as the key player. Obama built on this foundation. From his first inaugural until the end of 2015, Obama spoke of climate change in his official comments almost 800 times, and at times quite emotionally.[29] While Nixon's presidential leadership shifted and Obama's did not, both men projected the executive branch into issues of environmental quality in a way not seen since Theodore Roosevelt. Neither, it appeared, had much opinion of Congress when it disagreed.

One of the key goals of Obama's climate action plan was to lead international efforts to combat the problem. Here, yet again, the Nixon era set the template. With environmentalism growing around the world early in the 1970s, the United Nations planned for the Conference on the Human Environment in Stockholm, Sweden, in June 1972. Moynihan's 1969 memorandum to Ehrlichman had noted that climate change was a natural issue for NATO and members of the Nixon administration recognized that pollution crossed national boundaries and, as such, might require international cooperation. The meeting at Stockholm, Nixon's CEQ Chairman Russell E. Train argued, was a "major opportunity for positive U.S. leadership in world affairs."[30] As preparation for Stockholm commenced, Nixon also sought to use the environment as a way to encourage détente with the Soviet Union. Bilateral discussions commenced and, in 1972, resulted in an agreement for joint research and the exchange of scientists in several key environmental areas, including climate change. Nixon also tried to reach an agreement with the People's Republic of China on atmospheric nuclear testing, but made little progress.[31]

Stockholm was a significant event in modern environmental history, and as Train hoped, the United States launched its first significant environmental diplomacy, a field that later played prominently in the Obama administration. In Stockholm, delegates from 114 countries along with 400 reporters and representatives of nongovernmental organizations, debated for almost two weeks. In the end, the delegates agreed on a "Declaration of Principles" and an "Action Plan" to implement them. With the science of climate change still unsettled, the only significant accomplishment was to further expand and coordinate international monitoring and research. With Train at the fore, the American delegation unveiled Earthwatch, a research program focused primarily on monitoring the oceans and atmosphere for long-term trends. To encourage the reduction of fossil fuels and other environmental compliance, the conference established a fund to assist poorer, developing nations. The issue of funding, however, proved contentious. The environmentalist Train argued for an American contribution of $100 million, but the final figure fell significantly short at

$40 million. The developing world argued for greater compensation, insisting that the rich nations had already benefitted from industrial growth and were prohibiting their own countries' prosperity. The United States and Europe had caused much of the pollution but expected the Third World to suffer the most economically for it. As Obama would learn, this dynamic remained a constant in the years of international environmental diplomacy that followed.[32]

There was another problem at Stockholm that was less obvious. While the conference sought to portray all problems from pollution to soil depletion to ecological diversity in a global context, to a great degree, each of these problems still had sources and impacts that could be mapped onto existing geographical spaces controlled by established rulers and bureaucratic agencies. Pitched as global, these issues all fit, if somewhat awkwardly, into established international politics centered on measurable data and the economically interested nation state. Climate change, by contrast—fluid, borderless, and dynamic—had less obvious attachment to local or regional politics. It was still vague, not fully understood, and enjoyed no clear interested constituency. Stockholm was a start, but real progress would have to wait for leaders to follow.[33]

The reaction to Stockholm was telling. Environmentalism remained strong, and the 1973 Energy Crisis had not yet unfolded. Conservative Republicans had successfully fought the higher financial contributions that Train had advocated, and the Department of Commerce, undoubtedly representing the interest of a number of industries, had openly worried about possible new regulations on the horizon. For the most part, however, polls and newspaper editorials demonstrated wide public approval and strong bipartisan congressional support still remained. Train spoke of "capitalizing on the momentum developed at Stockholm" as Congress inserted praise of the American delegation into the *Congressional Record*.[34] Not yet fully appreciating how a Republican-led backlash to environmentalism loomed, Train agreed to lead a delegation to NATO's newly established Committee on the Challenges of Modern Society (CCMS). The CCMS was a product of Moynihan's efforts after his 1969 memorandum to Ehrlichman. Not surprisingly, several of its pilot programs aimed at cutting reliance on fossil fuels and combating possible climate change.[35]

By the early 1980s, most scientists had discarded the earlier, widely publicized theories of global cooling and begun to coalesce around the science of global warming. The First World Climate Conference took place in Geneva in 1979, and almost a decade later in 1988, the Intergovernmental Panel on Climate Change was formed under the auspices of the United Nations and directly flowing from the Stockholm Conference. At the same time, back in the United States, the partisan rift that had begun during Nixon's second term had expanded into a true chasm. A second round of energy shortages dogged the presidency of Democrat Carter and helped launch the tenure of Republi-

can Ronald W. Reagan. Even as the science supporting climate change became stronger, Reagan dismissed the central tenets of environmentalism. His antiregulatory stance and his efforts to defund the EPA and all climate change research meant that, unlike at Stockholm, the United States played a much smaller role in the unfolding environmental diplomacy. In Congress, growing numbers of Republicans joined the administration in its ideological drift to the Right and many discounted the Intergovernmental Panel on Climate Change as a liberal organization bent upon a one-world government.[36]

Nothing, however, put the climate more in the public eye than the ugly environmental events at the end of the Reagan presidency. A horrible heat wave hit the Eastern United States and a drought devastated the Midwest farm belt. The Mississippi River hit record low water levels and fires ravaged much of the West—all before a tremendous hurricane season. Suddenly, climate change was front-page news. Magazines, such as *Time*, *Sports Illustrated*, and *Newsweek*, all ran major stories on global warming. In the middle of the climatic upheaval and feeling pressure from America's allies, Reagan agreed to sign the so-called Montreal Protocol in 1987. While the agreement committed nations to cutting substances that depleted the ozone layer, Reagan worked hard to weaken the standards and remained resistant to the overall science. This brought him into direct conflict with a key ally and friend, British Prime Minister Margaret H. Thatcher, who acknowledged the science of climate change.[37] Reagan's successor, Republican George H. W. Bush, feeling the new pressure, promised to counter the "greenhouse effect" with the "White House effect," a hint that his administration might shift American policy again. Bush did push through the Clean Air Act Amendments of 1990, which sought to strengthen protections for the ozone layer by limiting chlorofluorocarbons, but in the end Bush largely found the growing resistance in his own party difficult to overcome.[38]

As his presidency wound down in 1992, Bush faced a dilemma when the United Nations sponsored a new major conference in Rio de Janeiro on the 20th anniversary of Stockholm. The United Nations Conference on Environment and Development, known as the Earth Summit, acknowledged a scientific consensus and debated significant, legally binding cuts in CO_2 emissions. While Bush ended up signing the UN Framework Convention on Climate Change (UNFCCC), committing all signatory nations to cutting greenhouse gases, the United States successfully fought specific emission targets and enforcement mechanisms and incurred the wrath of other nations as a result. Just as in Stockholm, the rich and poor nations did political battle, but unlike the earlier conference, the president received little praise upon his return. The Senate ratified the accord even as a growing number of Democrats decried it as toothless and an equally growing number of Republicans lambasted it as more expensive bureaucracy built on questionable science.[39]

President William J. "Bill" Clinton, a Democrat, promised more. By the 1990s, however, the partisanship had metastasized further. When Clinton negotiated and signed the Kyoto Protocols in December 1997, which provided the specific, binding limits on emissions lacking from Rio and encouraged by the UNFCCC, Senate Republicans led a successful campaign against the treaty, noting that it did not require adequate reductions from developing nations. Once again, just as with the Nixon administration at Stockholm, the chasm between rich and poor countries proved problematic. In the end, Clinton, assured of the measure's defeat, did not submit it for ratification. At the same time, a number of leading oil and coal companies formed the Global Climate Coalition, committed to disputing the now widely accepted science. Its members regularly contributed financial support to the congressional Republicans who took up their cause. When the coalition dissolved in the early 2000s, many of its supporters finding increasing difficulty in denying the consensus, a number of wealthy Republican donors and organizations took the coalition's place. Most acknowledged global warming but disputed an anthropocentric cause.

When Republican George W. Bush assumed the presidency in 2001, the growing scientific consensus was enough to get a new bill to limit greenhouse gases before Congress but not enough to overcome the entrenched partisanship. The Climate Stewardship Act, a relatively moderate proposal that foretold the cap-and-trade bill that Obama would later push, established a national greenhouse database, among other proposals, and was introduced several times by John S. McCain, Republican senator from Arizona, and Joseph I. "Joe" Lieberman, Democratic senator from Connecticut, first in 2003 and then again with revised provisions in 2005 and 2007. Each time, however, an overwhelming majority of Republicans blocked Senate action.[40] As Bush officially rejected implementation of the Kyoto Protocol, formally ending all hope of its approval, Democrats took testimony from scientists who claimed that the administration had applied pressure to change research results. Feeling his own pressure from the Group of Eight developed nations (G8), Bush proposed a plan to reduce greenhouse gases relative to economic output, but Democratic critics quickly noted that with economic growth assured, the greenhouse gases would continue to grow as well. It was, they argued, a sham. Published reports, moreover, claimed that Republican think tanks were colluding with the oil industry in coordinating a campaign to deny the science.[41]

The momentum, it was obvious, was building toward the presidency of Barack Obama. The foundation for activism and partisan discord had grown with each new president and agreement since Nixon's initial diplomacy. Taking his cue from Nixon, Obama immediately set out to tackle the issue. Like Nixon, he immediately felt resistance from Congress. Scholars have noted Nixon's "imperial presidency," his tendency to expand executive authority. Almost 50 years

later, critics decried Obama's expansive interpretation of existing legislation to augment his own power. It was unconstitutional, they claimed, continually seeking redress from the judiciary.[42] The many executive orders and memoranda that Obama used to implement his climate action plan after his 2013 State of the Union infuriated Republicans. Like Nixon, Obama did not care about angering his opposition. He plowed ahead.

As scientists noted that 2014 was the hottest year on record—only to be supplanted by 2015—Obama refused to approve the controversial Keystone XL oil pipeline from Canada, pending for years and in many ways a surrogate for the entire climate change debate.[43] In December 2015, as both parties prepared for the fight over his successor, Obama sought to assure his environmental legacy. Meeting with leaders from almost 200 nations around the world, Obama signed the Paris Accords, a truly landmark agreement that reflected just how far the climate debate had grown since Nixon. The agreement established no legally binding emission standards, which would have required Senate ratification and thus assured a quick death at the hands of the Republican congressional majority. Each nation, rather, agreed to set up its own targets and programs to achieve a broad goal of halving carbon emissions, reporting back to the others on five-year intervals using a universal accounting system and independent reviews. The system allowed for the consideration of new science and promised the publicity to assure compliance. Tensions were once again high between the rich and poor, but in the end, the agreement did assure even the developing world's compliance with the promise of new aid. "This agreement sends a powerful message," Obama proudly declared, noting that the "skeptics" had been proved wrong and that the future was going to be different.[44]

The future, of course, is never assured. Every major Republican presidential candidate in the 2016 election questions the science of climate change.[45] Scientific and political battles surely loom, just as they have unfolded in the past. What has been assured, however, is that Obama's environmental legacy will stand well into the future. His presidential actions have set the parameters for his successors whomever they may be—just like Nixon. In the end, Richard Nixon and Barack Obama, a truly odd couple, have helped address the concerns that Daniel Patrick Moynihan first raised so long ago. Nixon helped pave the road that Obama has traveled, and both deserve the legacies they have earned.

Notes

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Warmly Argued
A Brief Historical Look at Two Centuries of Climate Change Findings in Public Dialogue

Michael Reis

Abstract: Drawing on scientific and scholarly sources, the article offers a short examination of recurrent themes in the history of public and scientific dialogue concerning climate change science, from the nineteenth century to the past several decades. The article asserts that certain themes have affected quite powerfully the public dialogue about climate change, including the challenges of effective scientific communication and endeavor, reaching and improving on scientific consensus, and taking public action against climate change amid recurring limitations and obstacles.

Keywords: climate change history, climate science history, global warming history, public opinion and climate change

In 1957 when historian A. Hunter Dupree wrote, "In a narrow partisan sense, science has seldom been a political issue," he could not have envisioned the drama, over environmental issues generally and climate change specifically, that emerged in Congress during the last few decades.[1] Nor would anyone, most likely, have guessed at the changes to be made in the Department of Defense (DOD) in the same time period. But indeed, even the military has had to embrace changes in energy and environmental policy within its ranks. As one of the deputy assistants to the secretary of defense explained, "At the Department of Defense, we deal with risks all the time. That's what the military does.

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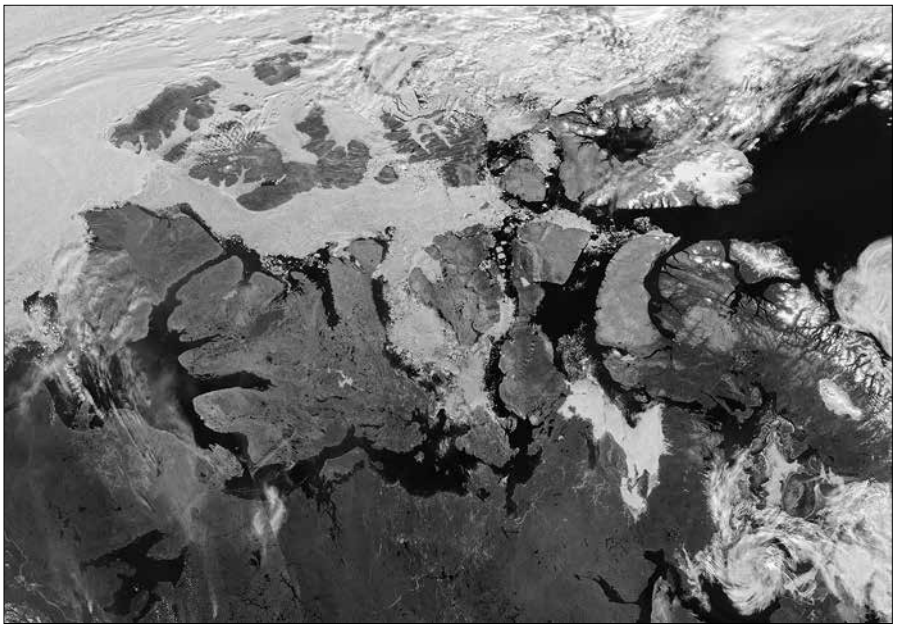
We evaluate risk and say, 'Well, given these probable scenarios, how should we plan to address them?' That is the military mindset."[2] Yet Hunter Dupree's and Maureen Sullivan's forthright statements bely the larger contentiousness of the issues caused by scientists and advocates pushing the issue of climate change into the public debate long before Presidents Richard M. Nixon or Barack H. Obama made their marks on American environmental policy.

To recount any part of the history of dialogue on the science and risk of climate change is to immediately encounter recurring themes. Since the nineteenth century, scientists around the world have looked into the causes and risks of climate change, but the public results of their inquiries have often been watered down because of various bulwarks created by institutional and technological obstacles, dissent from religious authorities and other nonscientific groups, and lack of consistent data. For those unaware of the historical context of the science behind climate change, these obstacles to moving the scientists' results into the policy realm might seem like new problems, but are in fact old ones. Consider for a moment just a few of the major investigators and popularizers of climate change, especially what was most popularly known in much of the twentieth century as "global warming": Svante A. Arrhenius (1859–1927), the Victorian-era, Swedish investigator pondering the levels and effects of CO_2 in the air; Guy Stewart Callendar (1897–1964), a British engineer appearing before a skeptical Royal Meteorological Society almost on the eve of the Blitz to present his pioneering conclusions that Earth had warmed since the late 1800s and that doubling atmospheric CO_2 would make it two degrees Celsius hotter; Charles David Keeling (1928–2005), an American scientist patiently gleaning atmospheric CO_2 data from Mauna Loa and Antarctica year after year during the Cold War; American professor James E. Hansen (1941–) delivering his jeremiad testimony in 1988 on Capitol Hill in the then-hottest summer on record; and former Vice President Al Gore (1948–) telling the necessary, if inconvenient, truth in an unlikely PowerPoint-turned-book-turned-movie hit. These names, which have become icons for the advocates of climate change, faced recurrent obstacles to getting their ideas accepted widely and fully integrated into policy.

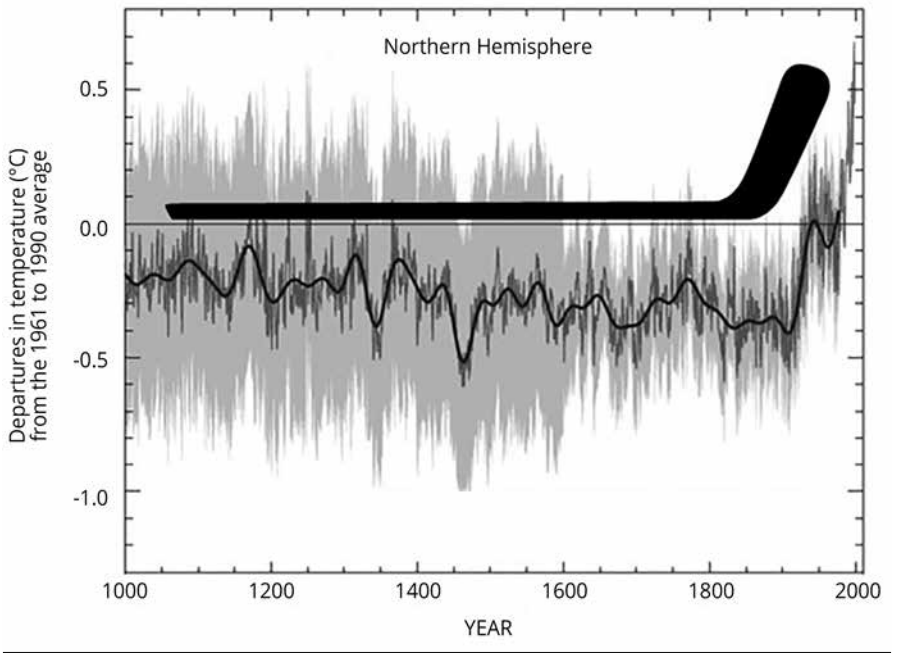
And abounding also are the strangely riveting conceptual and visual icons. Earth's air as a "greenhouse," heat "sinks," melting glaciers, stranded polar bears, and an open Northwest Passage (figure 1). Human icons have created their own visuals as well, including two justifiably famous and crucial curves. The Keeling Curve charted the steady rise of atmospheric CO_2 since 1957, and the Mann-Bradley-Hughes "hockey stick graph" of 1998 displayed global mean temperature increase with the recent business end of the "stick" evidently poised to take a nasty slap-shot at Earth if people do nothing or even too little (figure 2).[3]

Figure 1. Northwest Passage, 2013



Courtesy of National Aeronautics and Space Administration.

Figure 2. The Mann-Bradley-Hughes "hockey stick graph"



Courtesy of the Intergovernmental Panel on Climate Change, adapted by MCUP.

The icons in the climate change debate and the narrative behind it are certainly multiple and dramatic respectively, but the ironies and limitations under which successive scientific generations have labored in the past may in fact be even more telling because they have shaped present debate in unexpected ways. By placing the debate into a useful context, some insight into those historical ironies and limitations—how they have affected debate and discussion and how they have echoed and reverberated over time—may be helpful to those grappling with this worldwide challenge of the twenty-first century. This includes the basic history of the findings related to climate change and the major responses to them, which should offer an appreciation of certain key historical patterns.

The core objective for this article then is to show how today's climate change debate in the United States remains strongly conditioned by both positive and negative historical factors. These include the positive rise of collaborative team science, the participation of eloquent scientists in the public discourse, and the use of ever-more sophisticated and accurate tools to reach and improve scientific consensus as the strongest basis for policy action. But they also encompass the negative effects of the mid-to-late twentieth-century clamor of multiple environmental and societal crises demanding attention, relegating climate change to a lower priority amid such challenges as control of DDT and industrial pollutants. Additionally, the history of official action on the climate change "finding" as it has played out in scientific and public discourse dramatically reveals a decades-long delay between the basic nineteenth-century and early-twentieth-century discovery of anthropogenic climate change and the late-twentieth-century call to do something about it. We cannot alter the fact of the delay between establishing the scientific knowledge base and its serious consideration by the public and politicians. Yet, it may be helpful to recognize that because of it, and other factors, much of the modern discussion of climate change policy in the United States has been characterized by shifting public opinion that has only recently "caught up" to earlier findings, amid seemingly constant struggles on the part of scientists and concerned policy makers to effectively convey the urgency of the threat.

The article that follows neither tries to be a full primer on the science of climate change nor a comprehensive history of the subject; others have tackled and mastered those more detailed needs.[4] Rather, it seeks to set the modern U.S. climate change debate (1970s–2010s) in context by first providing a short overview of the key scientific and public developments prior to that, then examining some aspects of the more recent history to elicit insights into how modern debate and dialogue have proceeded under various, continuing limitations. Here, we will try only to shine a brief interpretive spotlight in an effort to

spot significant patterns, echoes, and reverberations as one means of "thinking in time" to aid current policy makers.[5]

One further prefatory note is worth making, which serves to illuminate key terminology and presages a major transition in public and policy climate change-related attitudes since roughly 1970. Over time, scientists and decision makers grappling with the basic findings have used a variety of words and phrases to characterize the basic problems and threats. Victorian-era and early twentieth-century observers might not have known what to make of such phrases *global warming* or *climate change*; experimenters, at the time, instead wrote of the "influence" and "effects" of carbon dioxide "adsorption" or "absorption." Gradually, scientists after World War II and into the 1970s, studies of CO_2-induced temperature increases began trending toward use of the term *climate* but paired it with variant nouns, such as *modification*. For example, Massachusetts Institute of Technology authors famously enshrined "inadvertent climate modification" in a 1971 technical report.[6] Global warming, though already in use by 1979 to denote one major climate impact, gained currency as shorthand for the entire problem thanks to popular press attention paid to the congressional hearings of 1989, including NASA Goddard Institute for Space Studies Director James Hansen's testimony.[7]

Ultimately, however, *climate change* rightly came to be accepted as the term of art for the overall issue and challenge, as scientists and policy makers began reaching a consensus that effects of the warming would include multiple impacts that might not always seem connected to global warming. Initially, *climate change* may have first appeared in a 1975 *Science* article written by Wallace S. Broecker of the Lamont-Doherty Earth Observatory, but it achieved its current and correct usage as referring to the array of possible long-term changes in Earth's overall or regional climates caused by CO_2 increases more recently.[8] In this article, we will generally use climate change as the term for the entire spectrum of climate effects, but we will also periodically refer to other terms, including global warming, when they are appropriate in their specific historical periods.

The Climate Change Debate and Discussion

Climate change as a finding of importance did not spring full-blown and ominous from the authors and producers of the movie *An Inconvenient Truth* (2006). It shares with other major scientific discoveries, such as ecological thought or the development of atomic theory, a fascinating two-century history replete with chance discoveries and wrong results, prescient guesses, and spirited and productive disagreements.[9] Yet what is so extraordinary, especially in light of these complexities, is that the central tenet—that Earth's atmosphere is warming at an unprecedented rate since the Industrial Revolution began due

to human production of greenhouse gases and such warming is causing many impacts—was effectively reached and largely agreed on by the 1960s within scientific circles, even before the advent of powerful supercomputers that allowed for the making of evermore sophisticated models of the atmosphere. These supercomputers, of course, made possible the "multiple model consensus" approach so critical to the conclusions of the National Academy of Sciences, the Intergovernmental Panel on Climate Change (IPCC), and other key institutional players since 1970. A look at how the central climate change tenet was reached and ramified suggests that scientists, though marked by the cultural, theoretical, and technical limitations of their time periods, nevertheless did a remarkable job of reaching a valuable consensus on the basic finding well before 1970. Yet a range of post-WWII limitations and suspicions, all related to the uneasy and often ironic interactions of science, society, and government since the 1960s—one might even say after Hiroshima and Nagasaki—have seriously affected the climate change debate and the search for a unified national and worldwide approach to solutions.

Nineteenth-Century Icons Lay the Groundwork

While Hollywood, in countless biopics, has romanticized the Pasteurs and Edisons, it is true that the period from the Battle of Waterloo through World War I, which saw the first basic work done on global warming, was a period of science commanded by strong, frequently iconic international figures dominating laboratory resources to go after key empirical data but who were also often hobbled by isolation. Moreover, while laying the groundwork for much of the science that would be built upon their work later, they were limited theoretically and analytically. Important events and trends in the nineteenth century included work done by Joseph Fourier, Louis Agassiz, John Tyndall, and Svante Arrhenius. In 1824, Joseph Fourier, a mathematician, completed calculations that demonstrated that atmosphere influenced world temperature and that Earth would be much cooler in the absence of an atmosphere. Fourier, in realizing that the atmosphere acted to keep in a part of the heat emanated from the Sun, also was first to offer the simple comparison of Earth to a glass-covered greenhouse.[10]

Following Fourier, nineteenth-century advances were prompted by true icons in the history of science who helped fill in the gaps of the big climate picture even as they pursued other goals. In the 1830s, Louis Agassiz used his expertise in geology to add to the collective knowledge by postulating that Earth had gone through one or more ice ages, and thus the world was far more dynamic than was considered at the time and was influenced, albeit in the relatively distant past, by large-scale rapid, catastrophic climate change. Though focused on dramatic cooling trends, Agassiz and his followers showed that

Earth's past history was marked by major events that had an impact on climate. Efforts to learn more about ice ages continued to prompt many investigations into global temperature variations.[11] By 1859, the physicist John Tyndall asserted that certain gases in the atmosphere acted to stop infrared radiation and that climate could change if gas concentrations increased. Tyndall crucially found that CO_2, in particular, was opaque to infrared radiation and materially contributed to a heightening of Earth temperatures.[12] Near the end of the century, another human icon responsible for basic discoveries in chemistry, Svante Arrhenius, went beyond a possible reason for why Earth grappled with CO_2 concentrations, showing that indeed its climate was more sensitive than previously considered. In a pioneering look at what is now termed *climate sensitivity*, Arrhenius famously demonstrated that either cutting in half, or doubling, CO_2 atmospheric concentrations could mean a 4–5 degrees Celsius change in average Earth air temperatures.[13]

Overcoming Limitations

For all these breakthroughs, however, the limitations suffered by nineteenth-century investigators, such as those named, were indeed severe. First, although scientists communicated with each other personally, via journals, and through such self-appointed governing groups as the Royal Society of London for Improving Natural Knowledge (or simply the Royal Society), the discipline of science as a large, well-funded, and officially backed worldwide endeavor with an available "army of labor" did not yet exist. No wide-ranging, regularly convening conferences or panels met, and investigators thus worked in comparative isolation, pursuing research as far as they could but sustaining few long-term collegial teams or ties across national or educational boundaries. Yet, public faith abounded in practical science and technology, often cast in nationalistic terms, while scientists strove for means to make a larger impact on the knowledge of the world. Second, research efforts to build on and deepen understanding of findings were hobbled by the lack of an army of researchers to systematically collect evidence from around the world, as well as by the lack of sufficiently sophisticated measuring and computing instruments able to crunch such data, assuming it had been available. Arrhenius, for instance, posited largely correct conclusions, but he and his collaborators simply were unable to collect the more comprehensive data that would have been needed to fully explicate the findings on climate sensitivity.

Third, tests and findings were set against a backdrop of titanic, unresolved struggles over larger, first principles about Earth and atmospheric science. Conflicts such as the Darwinian debate over evolution, the geologic dispute over catastrophism and uniformity, and the battle over the age and origins of

the world overshadowed experimental scientific concerns about the atmosphere and any impacts on it from European and American industrialization. While communication and data collection had hobbled scientists in collecting data and testing their hypotheses, other social factors—such as the Catholic Church's insistence that evolution and, indeed, any ideas of planet-wide changes were false—formed a well-funded, respected, and long-lasting opposition to many of the scientists' fundamental premises, most of which became the basis for our present understanding of the world. Religion-based views that processes of the earth and air were essentially unchanged and unchangeable since creation still were prevalent in the eighteenth and nineteenth centuries. This may have provided comfort to people confronted by the dislocations of the Industrial Revolution. Thus, the idea of rapidly occurring global, or even regional, catastrophes in Earth history routinely encountered entrenched enemies. These ideas posited by Agassiz and other Ice Age investigators came under attack, foreshadowing more recent popular suspicion of scientific predictions of the imminence and speed of the potential catastrophe represented by climate change.[14]

With all of these issues at hand, scientific inquiry into global warming and climate change, thus, could not move too far forward, let alone influence policy makers for a variety of reasons. As seen from the discussion above, science institutionally was neither unified nor well-funded as a profession, data was scant, and instruments were minimally refined. Moreover, basic matters regarding atmospheric and climate dynamics—rapid changes versus static timelessness, the interactions of air and ocean, feedback loops among simultaneous processes—were just beginning to be addressed. Nonetheless, a kind of loosely defined research program focused on these topics and questions had begun to emerge by the end of the nineteenth century as international scientists continued their research.

Overall, debate and dialogue about climate change science in the nineteenth century took place almost entirely within the realm of individual scientists communicating via personal and professional networks of letter writing and publications. The debate did not spill over into the arena of politics and government, either national or international, because as yet no problem requiring official actions had been identified given that the fundamental concept of geophysical change was still questioned in many quarters. The pattern of creative scientific dialogue within science was set, however, and would flourish as scientific communications and research data and techniques got much better in the twentieth century. Moreover, governmental interest in what the scientists were doing and thinking grew, as expressed by greater funding but also greater controversy.

Making a Public Problem

Science as a professional discipline was utterly transformed in the tumultuous twentieth century, and the old nineteenth-century iconic-style of climate change investigation and discourse was transformed along with it. While discussion of global warming as a major climate impact under the full public spotlight did not occur until well into the 1960s, the basic science needed to have this conversation greatly expanded and deepened before and after WWII, driven by U.S. federal and institutional funding. Although sophisticated modeling of the atmosphere awaited exponential increases in digital computing power, scientists developed a consensus approach to identify atmospheric CO_2 and global mean temperature rise as signs of a crucial problem. The problem, in turn, began to be defined as an important public issue for policy makers and scientists to address. Because many people involved in current debates and decisions may be unaware of the pre-1970 era science related to climate dynamics, it is even more important to consider some of the crucial events and trends in the twentieth century. These events laid the groundwork for understanding the push for broadly based consensus and response to climate change, as well as delineating patterns of delayed recognition of the issue and consequent challenges to that response.

Professionalizing Meteorology

Prior to and during WWII, the professionalization of meteorology—in the interest of better prediction capabilities—prompted enhanced governmental and university data collection concerning climate characteristics and processes.[15] The National Oceanic and Atmospheric Administration's (NOAA) precursor, the National Weather Service and other weather services, began to secure more refined data on a wider range of variables and conditions. Though often focused on localized, or at most regional "weather," rather than broader climate change, this effort nevertheless provided methods for sorting out climate complexities (e.g., laying to rest such myths as "rain follows the plow").[16]

Reflective of the new involvement in the climate change-related science of meteorology was the work of British scientist Guy Stewart Callendar, whose ideas strongly resonated in the U.S. scientific community after WWII. Essentially an engineer who had taught himself meteorology, Callendar built on extensive meteorological observations from 147 weather stations to conclude in 1938 that global temperatures had risen due to CO_2 creation by human-generated "fuel combustion" by about 0.3 degrees Celsius since 1888. In light of later debates, it is interesting to note that, in 1960, Callendar speculated that his assertion was not too well-received in 1938, in part, because it focused on a single factor rather than a complicated array of forces. Callendar also had presented the then-still shocking assertion that humans could actually influence

something as large as global climate over time. Moreover, before 1938, other meteorological studies had focused instead on water vapor absorption rather than CO_2 atmospheric content. And lastly, Callendar only half-joked that his 1938 scientific audience "did not think of it themselves."[17]

Callendar's later reflections underscored the reality that his scientific voice, though ultimately the one closest to climate change truth in the early twentieth century, was by no means the only one heard at the time. The greater professionalization of meteorology and other climate-related science did not immediately lead to a consensus on climate change findings, let alone the need to take policy action. Historian James Rodger Fleming has documented well how the availability of more sophisticated technical and experimental methods produced a varied array of sometimes conflicting analyses. Fleming posits that "in the first half of the twentieth century, most scientists did not believe that increased CO_2 levels would result in global warming" and that "other mechanisms of climatic change, although highly speculative, were given more credence, especially changes in solar luminosity, atmospheric transparency, and the Earth's orbital elements."[18] Overall, meteorologists provided more concrete data, but not as many advances in producing correspondingly well-accepted interpretations.

Pioneering Publication and Public Discussion

As science became more professionalized and, indeed, more "global" during the first six decades of the twentieth century, multiple scientists began to use official venues and sponsorship to revisit, reassess, and eventually reaffirm the basic Arrhenius-Callendar conclusions regarding anthropogenic CO_2 and its effects on Earth.[19] Historian of science Spencer R. Weart has aptly noted that, beginning in the 1950s, Cold War concerns ironically freed up more military money to investigate CO_2 and temperature rises in the United States, especially in the wake of the Soviet launch of the first artificial satellite. Globally, scientists were supplemented with funding from the International Geophysical Year, a late 1950s initiative toward expanding global science.[20] Official funds, thus, backed breakthrough studies by various scientists, such as Gilbert N. Plass who found that adding CO_2 to the air would materially affect the radiation balance, Hans E. Suess who studied how ancient carbon released through fossil fuel combustion was significant, and Roger Revelle who proved that anthropogenic CO_2 was not easily absorbed by the oceans.[21] Keeling's patient and persistent measurements of rising atmospheric CO_2 concentrations likewise benefited from a continued, if sometimes unpredictable, influx of federal money.[22]

With the availability of fairly regular funding, a core group of scientists focused on climate change began to emerge and contribute to official reports well before 1970; these reports collectively represented the first benchmark

achieved by modern climate science, which got noticed in the United States. Though called by other names, including global warming or greenhouse gas forcing, climate change began to take its place as one among many defined environmental challenges the nation was facing. Though Revelle appeared before the U.S. Congress in the mid-1950s to testify about CO_2-induced climate changes, 1965 marked the key year in many ways. As Weart has noted, Revelle and his Scripps colleagues were at the heart of a National Center for Atmospheric Research conference on causes of climate change in 1965, but that was also the year when the President's Science Advisory Committee subpanel reported that climate change as one of numerous environmental problems was, nonetheless, real and a topic worth of public policy concern, warranting further study by the National Academy of Sciences.[23] The National Academy's inclusion of the climate change problem on their list of issues meriting more study was, in itself, a significant, early acknowledgment of the emerging scientific consensus around the topic; it also served to underscore that interested policy makers should recognize that scientists concerned with the issue were now continually seeking broader consensus, rather than isolated findings, as the best contribution they could make toward any public action. Yet, further investigations in the 1960s and 1970s spelled additional delay in any serious governmental actions or expenditures to halt or retard the effects of climate change.[24]

Getting the New Science into Policy

Though science, long before 1970, had thrown off the limitations of isolation and sparked official interest in what proved to be the right climate change findings, serious work, nonetheless, ran into significant constraints of its own when it came to spurring and steering public action. Indeed, science and data collection had become more systematic but also more complex, as multiple investigations pointed squarely to the need to collect still more temperature and CO_2 data measured over longer periods of time, as evinced by Keeling's long-term commitment to sampling at Mauna Loa and Antarctica. Increasingly, this was how science best and most successfully proceeded—by repeated and varied experiments and testing hypotheses against a pattern of honest admission of theoretical and data gaps. But policy makers, alerted to the overall problem, needed a clear and loud alarm to mandate major official action backed by citizen support. Hence, they still had difficulty doing much more than entertaining, and sometimes granting, further funding for investigation of the problem.

Understanding the reasons for the disjunction between the scientists and the policy makers, which ultimately delayed any serious policy actions until much more recent history, may be instructive to today's officials who still grapple with converting scientific recommendations into clear and sensible initiatives. Science admittedly was reluctant to say "case closed" to policy makers, let alone

make specific recommendations for change, when, in fact, the state of the field and appropriate scientific protocols both called for more and better research as well as refinement of atmospheric theory and models. The new challenge, rather, was for policy makers to forge ahead on the strength of the basic conclusion that anthropogenic climate change posed a serious threat, even while supporting further research and theoretical discussion. The risk, now a familiar one, in the 1960s and 1970s was that fostering more "science" might well lead to still more questions about how best to define climate sensitivity and the range of likely climate impacts that the very policies were supposed to mitigate.

But a second reality of the pre-1970 era made doing all of this even more difficult if not well-nigh impossible. The global warming problem, even as it began to be cited in official reports of the 1960s, was just one among many environmental and social issues crying for attention, and those other issues appeared far more urgent. Clarion calls about modern, urban postwar problems, such as Rachel Carson's *Silent Spring* (1962) and Ralph Nader's *Unsafe at Any Speed* (1965), were heard and acted on precisely because such problems as water pollution, pesticide poisoning, and automotive defects were readily grasped as having actually killed animals and people at the time. These problems had what were seen as relatively simple solutions compared to the potential complexities of responding to the longer-term problem of climate change (i.e., clean up the industrial sludge or oil spills, restrict or ban pesticides, and get rid of factory defects in cars). Issues such as these were hardly free from political pressure; many manufacturers, at first, lined up against new regulations, a pattern to be seen later in the climate change debate. It was hard for anyone to mobilize in favor of action on climate matters when science itself wanted more data and more refined atmospheric theory while pressing problems were easier to understand and try to solve.

Perhaps scientists could have done a better job of forthrightly explaining to the public and governments that anthropogenic climate forcing was a more urgent (if more complex) matter requiring action. Based on the evidence, it is hard to say so, largely due to more intractable problems. During the world war, the nation mobilized with the help of the government, creating a military-industrial complex that won the war on two fronts. Yet the bureaucracy that brought the nation to victory did not look as good to Americans after the war. Growing public suspicion after World War II, on the Left and Right, of government and the scientific "establishment" began to intrude on this interaction and become widespread by the end of the 1960s.

Though scientists were traditionally independent and did not have a single "spokesperson" or group, science along with government even in the 1950s was already blamed in many quarters as having brought the mixed blessings of the atomic age. If "atoms for peace" brought benefits of atomic energy that could

be part of the legacy of Los Alamos, New Mexico, so too were fallout and the fear of mutually assured destruction in a third world war. NASA achieved John F. Kennedy's dream of moon exploration, but the Manhattan Project-scale investment in the Apollo program occasioned questions about whether funds should ever again be spent at such a level for any purely scientific challenge. Then the puzzling military loss in Vietnam, despite large expenditures of lives and money, coupled with the later revelations of widespread official misdeeds in the Watergate era, led to a "credibility gap" where the public no longer maintained a general faith that everything the government said or recommended was right, particularly if it required a major taxpayer commitment.[25]

Though policy action on global warming was delayed and wanting for these reasons, twentieth-century climate science up to the early 1970s had, on balance, achieved two accomplishments significant for the era and the future. First, scientists had given a comprehensive grounding to the more sporadic earlier findings and had begun to agree that the research agenda had essentially moved beyond simple assertion of the reality of global warming to a full consideration of what specific climate impacts could be anticipated and when and how, as a potential basis for a constructive and meaningful policy response. Policy reports began to cite climate change as an issue demanding some attention, albeit among many environmental problems clamoring for funds. And second, through official funding, in part, that spurred more comprehensive data collection and theoretical study, the core group of experts around Revelle and his colleagues and collaborators had established the building and communication of scientific consensus over workable models as critical in providing a credible springboard for any policy actions. The latter accomplishment, easily as much as the former, would come to characterize climate change scientific and policy-making work since circa 1970, including the public debate and dialogue we see today.

Reaching for Consensus after 1970

If a basis for understanding climate's effect on people was laid between 1824 and 1970 for scientists trying to reach agreement as a means of communicating findings and spurring policy, seeking consensus around climate change in the nation and the world since 1970 has become a praiseworthy and necessary, if not critical, goal. Scientific collaboration and consensus building about climate change is praiseworthy because that is how science and policy should best proceed; it is necessary and indeed crucial because the urgency and global reach of the problem means that national and international action cannot be delayed, even though data gaps and perhaps theoretical disputes persist. Broad and deep consensus, in fact, has come to be the most powerful policy tool contributed by science to policy making since the 1970s. Highly reflective of this has been

the now-regular, periodic discussion of findings and research gaps, through the vehicle of U.S. groups, such as the National Academy of Sciences, and bodies in which the United States are instrumental, notably the IPCC, the key international policy-setting forum formed under United Nations (UN) auspices in 1988. Rather than offering isolated though striking results, as Arrhenius, Callendar, and in the early years of the investigations Revelle did, scientists increasingly since 1970 used more formal groups to funnel their information for more effective consumption by policy makers and the public.

Ultimately, the scientific community and its supporters pushed its concerns to the forefront, despite renewed political questioning about whether the basic findings on anthropogenic warming were valid. This left, however, the field open for the still-vibrant dialogue as to questions of "climate sensitivity" (i.e., what climate effects would occur and when they would likely happen). Yet the dramatically greater public spotlight shone on climate change since 1970 also injected all manner of public debate and dialogue into the often fickle and shallow daily news cycle. At the same time, an array of fears arose and were stoked as questions materially affecting policy decisions and potentially large public expenditures emerged. Many of these fears were reverberations of older, entrenched popular suspicions, including beliefs that science and government, having brought decidedly mixed blessings on other social and technological fronts, could not be trusted. Policy questions were bedeviled by the difficulty of recognizing and allocating sizable funds to combat an environmental problem that was as yet only one of many and that public opinion, so critical to public action, was still struggling to apprehend. Though the danger of studying such contemporary history is that the historian is still a witness to its continued unfolding, a review of the key trends seen since about 1970 in the climate change dialogue provides crucial context to understand what is in today's—and the future's—news and how the facets of the current climate change dialogue evolved and became established in our recent past.

Computers, Risk Analysis, and Data Collection

If old fears were stirred and public views in the United States about climate change varied, science immeasurably aided policy makers by grounding the new consensus building in broadly collected data and corroborative analyses, rather than isolated observations and theories. Echoing the early-twentieth-century professionalizing of meteorological instrumentation, the advent of exponentially better computing capabilities after 1970 profoundly affected climate change science, allowing for evermore sophisticated atmospheric and earth sciences modeling. The dramatic increase in computing power, perhaps the greatest boon of the modern era, has permitted better scientific simulation of complex interactions. This includes feedback processes, involving such

phenomena as clouds, storms, albedo, and reflective characteristics of terrain and sea; El Niño and La Niña events; the thermohaline circulation of ocean currents; paleoclimatology, as a distant yet direct successor of Agassiz's Ice Age findings; and ice melting. While models and modeling were continually improved, reaching a "critical mass" of multiple models in agreement became a prerequisite of meaningful policy actions. Models being created by the late 1990s began to permit playing out of various risk-level scenarios as well. Scientists were for the first time able to ask and also reliably answer questions about how soon climate warming will reach a "tipping point" or how much sea level increase will come from various calculated potential temperature rises.

With the rise of sophisticated computing and especially the tremendous expansion of the Internet, beginning with its pre-1980 federally sponsored scientific precursors, such as DARPANet, data collection on climate change around the world expanded and truly engaged for the first time an army of labor. Even as computers and computing got better, instrumentation and techniques available to investigators underwent major change and improvement. Setting climate trends in a valuable paleoclimate context, by measuring previous changes using ice cores, was one powerful example of such increased capabilities. The responsibility of governments to cooperate with, and hopefully foster, scientific data collection also expanded to all parts of the world. Nations signed on beginning in the late 1980s to the UN framework that prompted creation of the IPCC, after what might well be considered a kind of "pilot" project combating a different yet analogous threat. Under the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, UN participating nations were able to come together to restrict chlorofluorocarbons (CFCs) and their impact on the ozone layer.[26] From the 1980s on, national governments, including the United States, began to recognize the value of the new, more comprehensive data and strove to come to consensus, much like the scientific community, regarding appropriate global environmental policies.

Climate Change Studies, Programs, and Reports

With climate change emerging as a key issue by the 1970s, the door opened for more systematic and sustained climate change programs and studies to be done, issuing influential reports on the national and, eventually, the international fronts. In the United States, these programs were first spearheaded by the 1970s studies sponsored by the National Research Council and National Academy of Sciences. Climate change study programs also benefited from greater funding for federal agencies, such as the EPA, NASA, NOAA, and DOD, all of which gradually posited climate change as a national risk (though still one among many in the 1970s and 1980s) that needed to be better understood so as to properly develop policy responses.[27] Publication levels of federal studies re-

flected this pattern; a search of the EPA's online database, the National Service Center for Environmental Publications, reveals 5,878 hits on "greenhouse gas" and 2,900 hits on "global warming;" the earliest such hits were for EPA studies dating from 1974 and 1980, respectively.[28]

But the issue clearly now was entering public policy discourse, with calls for more research, yet also striking an increasingly urgent tone. Many histories note the 1977 National Academy of Sciences's report indicating that neither panic nor complacency should be the reaction to the basic findings; the 1979 National Academy of Sciences's conclusion that doubling CO_2 concentration would occasion a 1.5–4.5 degree warming; and the 1983 EPA report whose very title, *Can We Delay a Greenhouse Warming?*, all revealed the shift toward a serious policy response. Similarly, a key 1980 report, prepared by Mitre Corporation for EPA's Office of Strategic Assessment and Special Studies, included strong language presaging more recent warnings incorporating risk analysis and climate sensitivity. The authors did not mince words with the following statement, "Increased concentrations of CO_2 in the atmosphere could profoundly and irreversibly alter global climate. Regional climate shifts could reduce the capacity of major world supply food regions to feed mankind, leading to disruption of international food markets, food shortages, or rationing." The Mitre team then hit upon topics that have been the subject of concern for a number of government agencies, including the DOD: "Other possible effects include changes in regional hydrology and rising sea levels due to polar ice melt. Coastal development, recreation, agriculture, water intensive energy, and industrial facilities, and resident populations could be affected on an almost unimaginable scale."[29]

Set against this rising tide of ever-more urgently worded reports, NASA's Goddard Institute for Space Studies Director James Hansen's landmark congressional testimony of 1988 represented the first culmination and realization of a trend that had begun much earlier. Hansen, as is well-known, dramatically brought home to Congress the emerging scientific consensus that human activities were "forcing" CO_2-induced climate change; such forcing had to be hindered or stopped or else humanity would face potentially irreversible impacts. Given that so many warning bells were going off in so many quarters in the decade before Hansen's congressional appearance, it is perhaps a bit ironic that his forthright restatement of an already strong scientific consensus became the storm vortex it did in the media. Yet what set Hansen's testimony apart was his unequivocal assertion that potentially irreversible warming was already underway, as the nation reeled from droughts and the hottest summer on record. Others in the 1980s, such as former EPA Administrator Russell E. Train, had publicly underlined the challenge and danger posed by global warming but had indicated that the rates of warming were still unclear.[30]

Americans Were Listening

Picked up by the *New York Times* and worldwide media outlets, Hansen's testimony—"that the greenhouse effect has been detected and it is changing our climate now"—was indeed galvanizing enough to provide a lightning rod against which numerous others in the growing debate could react.[31] With the old limitations of scientific isolation and predigital-era uncertainties largely gone, the thrusting of the global warming issue forcefully and dramatically into the public eye led for the first time to significant debate and discussion beyond just the scientific community. Such conflict centered on an array of questions that played out, often superficially and regrettably, in the charged, deliberately "contested zones" of the media and official hearings. Public polling in the immediate wake of the testimony documented an extraordinary uptick of concern among U.S. citizenry; as noted by historian Spencer Weart, in September 1988, some 58 percent of Americans recalled having heard or read about the greenhouse effect, a major rise from just 38 percent in 1981. Most perceived global warming as a threat and believed they would live to experience the impacts of anthropogenic climate change. Other polls documented that more than 80 percent surveyed worried about global warming.[32]

Yet longer-term surveys charting public opinion about climate change in the first two decades after 1988 revealed some troublesome fluctuations and uncertainties in popular views, which affected, and were in turn affected by, both scientific and public policy events occurring in the longer wake of the 1988 Hansen testimony. Specific awareness of climate change as a problem remained quite high, rising through the 80–90 percentile range from 1998 to 2006. By 2007, however, only 22 percent believed that they understood the problem very well. Belief in the reality of the global warming threat likewise rose from 68 percent in 1992 up to 84 percent in a 2007 survey, but confidence that scientists had indeed reached a consensus increased from 28 percent in 1994 to only 65 percent by 2006. Despite the Hansen testimony, only about one-third of Americans in 1989–91 worried "a great deal" about global warming as opposed to other environmental issues; between 1997 and 2007, this number rose to just 41 percent, with most reporting that they saw much more of a threat in water pollution and drinking water impurities. In the late 1980s, a large majority preferred "immediate action" against climate change even if costs were high, but by 1998, only 39 percent believed the need was serious enough to incur significant public costs. Significantly, in light of the scientific consensus regarding the urgency of the climate change threat, in both 1997 and the period of 2001–5, only a "bare majority" thought that any impacts had already begun; this rose to 60 percent in 2007, possibly in the wake of *An Inconvenient Truth* in 2006 and related media coverage, but still only about one-

third of the public felt that they would experience any adverse effects within their lifetimes.

If popular grasp of the details of U.S. involvement in international climate change talks and treaties typically scored low, public support for participation in worldwide emission control and reduction was steady. Immediately after President George W. Bush's 2001 controversial decision not to support the 1997 Kyoto Protocol mandating emission reductions in industrialized nations, surveys found that nearly 20 percent more respondents disapproved of U.S. inaction than approved. Support for particular domestic governmental policies also remained remarkably robust and consistent. Opinion surveys from the 1990s to 2007 showed strong support for emission limits on industry and automobiles, production of hybrid vehicles, and tax incentives to encourage energy efficiency and alternative energies, such as solar and wind. There was more division over increasing nuclear energy as well as considerable opposition to increased gas or electricity taxes aiming to influence consumer behavior.[33]

These variations in the polls pose a further and seemingly ever-present challenge to national policy makers seeking a political or civic mandates, to build on the broad scientific consensus, as the basis for action on climate change. The gaps and uncertainties in popular views may reflect the impact, during the past three decades, of specific events as well as echoes of past limitations. The pattern of "awareness without knowledge" of what climate change is and entails seems to dovetail with the drop in support for immediate, potentially costly action and the related belief that impacts will not be felt within the lives of those polled. Historically, these results suggest a continued impact of the decades-long official delay on the part of government in recognizing the climate change threat and according it the highest priority. Yet, also evident in these poll results is the effect of active opposition to climate change responses—or even renewed denial of the basic findings—rooted in part in continuing suspicion of big science along with big government solutions. Pinpointing another lingering reverberation from the Watergate and Vietnam eras, Meg Jacobs in her recently published *Panic at the Pump* aptly noted that "the rise of antigovernment sentiment has compounded Washington's inability to deal with twenty-first century energy challenges" and that "this hostility to government resulted in part from the unsuccessful efforts to solve the energy crisis of the 1970s."[34]

Thus, a question that persisted in some public debate, inevitably if amazingly, has continued to circulate: is climate change caused by human activities real? Yet because doing something about climate impacts required policy decisions affecting a critical economic sector—namely, the fossil fuel industries, just coming off the tumult of OPEC and the gasoline shortages of the 1970s—coal and oil representatives in particular reacted, in part, with an orchestration

of doubt. Just how urgent and global was this supposed challenge; what could effectively be done about it; who should do it; what was it going to cost; and who will feel the impact? Joshua P. Howe, in his study *Behind the Curve: Science and the Politics of Global Warming*, delineated the early 1990s arguments offered by these industries and their political allies, who joined in a "Global Climate Coalition" lobby under the pressure of Hansen's testimony. Many of the critics' points first expounded more than two decades ago remain characteristic of current opposition to strong action to combat climate change. Howe found that opponents asserted that the science was not yet fully "in" and verified; that climate change might be not as much of a problem if temperature rises were small; that "climate variation might result from natural, not anthropogenic, processes"; that global climate might somehow be "self-correcting"; and that it would be "an economically disastrous crash course" to mandate reduced carbon emissions if the science was uncertain.[35]

As climate change scientists finally reached a consensus and forced the issue into the serious policy and public funding spheres, deniers and skeptics also gathered steam to bring doubt to the conclusions of the proponents of mitigation. While outright denial of anthropogenic global warming and climate impacts unquestionably affected the nature and pace of official U.S. actions, the questioning raised in the 1990s and since has also ironically had the effect of making both stakeholders in science and policy "up their game" (i.e., ensure that decisions concerning climate change affecting government commitments and funding are grounded as solidly as possible in defensible, reproducible, and widely endorsed findings).

Stewardship Takes (Re)New(ed) Forms

Perhaps spurred by such strident opposition amid clear public concern and a rising scientific consensus, the 1990s and 2000s also witnessed a significant counterpoint: an outpouring of new (and interestingly renewed) kinds of public stewardship in the face of climate impacts. By 2000, under shareholder and consumer demands, as well as the press of IPCC findings, the industrial Global Climate Coalition had disbanded, as many U.S. industries doing domestic and international business began to realize that reducing emissions was broadly popular among their American customers along with foreign host countries. Hansen and his scientific colleagues continued to publish and testify at hearings, but also benefited from vocal partners and proponents in the policy sphere, such as Al Gore, who had presaged his 2006 *Inconvenient Truth* book and film with an equally strong plea in his 1993 *Earth in the Balance*.[36] Keying on Earth Day (established in 1970), the decade of the 1970s had seen popular stewardship that included a number of related smaller movements. For example, with the "small is beautiful" trend toward organic farming and living simply, believing that act-

ing to achieve local environmental gains was thinking globally. The challenge posed by climate change gave new life to this approach, as "carbon footprints" were assessed and "sustainability" criteria were applied to every human activity. Typical of the new, highly popular "act locally" guidebooks was David de Rothschild's 2007 *The Live Earth Global Warming Survival Handbook*. The book was published as the "official companion to the Live Earth Concerts," themselves a new forum for climate action, and featured "77 essential skills to stop climate change—or live through it." De Rothschild firmly, but entertainingly, offered ways to reduce CO_2 emission that included "get hitched," "say no to Styrofoam," and "ride the train," while concluding only half tongue-in-cheek with "colonize space," "pack a time capsule," and "evolve."[37]

The Past Informs the Present

Certainly, Hansen and others in the late twentieth and early twenty-first centuries have proceeded without interruption to act as Roger Revelle had done in an earlier time: warmly arguing yet working together to reach consensus on findings and related actions, while defining further research agendas to fill data gaps through creative experimentation and to push the science of climate change forward.[38] Meanwhile, amid the emerging public consensus that the problem was real and, at least, somewhat urgent, U.S. and international official actions began in the wake of the crucial 1970s and 1980s affirmation of the basic findings and challenges. While sustainability in a thousand ways captured public imagination and fervor, another new but enduring official stewardship response to climate change represented an illustrative instance of its increasingly routine incorporation into high-level policy. Perhaps ironically prompted by 11 September 2001 and the potential threat to national security climate impacts implied, the DOD under President George W. Bush in 2003–4 commissioned two futurists, Peter Schwartz and Doug Randall, to prepare a report on "an abrupt climate change scenario and its implications for United States national security." Schwartz and Randall urged defense policy makers to "imagine the unthinkable" regarding "significant global warming" to "better understand the potential implications on national security." Assessing possible regional impacts, such as droughts and famines, they spun out possible "conflict scenarios" that included stresses and risks from migrations and border wars linked to changing amounts of resources. Among their conclusions were that predictive models and metrics needed improvement, and that "adaptive responses" to events driven by climate change should be "rehearsed" by government and military planners much as they rehearsed, gamed, and drilled for other contingencies.[39]

Though U.S. legal developments such as the 1990 Global Change Research Act may have represented only a start in combating climate change, more

recent federal actions have included a more regular and systematic reexamination and review of U.S. funding priorities for climate change research, a process begun in 2009, as well as the early 2016 issuance of a DOD directive mandating that "the DoD must be able to adapt current and future operations to address the impacts of climate change in order to maintain an effective and efficient U.S military."[40] This important directive hearkened back to the Schwartz-Randall report of 2003–4 but also to a long tradition of military preparedness planning, which historically had included forecasting for meteorological impacts, such as floods and storms.

Last, but emphatically not least, a significant historic triumph for science has also been a policy-making recognition that the consensus-by-multiple-atmospheric-models approach is valid as a means of determining the validity of new findings and of appropriate mitigation and adaptation strategies and policies, including how best to assess the rates and impacts of climate change. The international actions, with the United States once more deeply committed to participating, especially reflect this; flowing from the pioneering Montreal Protocol to restrict CFCs, the successive post-1990 IPCC meetings and reports down to the pathbreaking UN Climate Change Conference (COP21) in Paris through December 2015 have moved too fast for some and too slow for others, but have consistently adhered to this approach in confirming and presenting scientific conclusions as springboards for policy.[41] Even die-hard critics in the U.S. Congress—those engaged in questioning data and sometimes the methods and credibility of those presenting—have perforce subscribed to the power and meaningfulness of the consensus-building approach, forward-thinking but with deep roots in the iconic days of Callendar and Revelle.[42]

Notes

The views expressed here are the author's and do not represent the views of History Associates Inc. or its clients.

1. A. Hunter Dupree, *Science in the Federal Government: A History of Policies and Activities to 1940* (Cambridge, MA: The Belknap Press of Harvard University Press, 1957), 379.
2. Francesco Femia et al., "Dangerous Intersection: Climate Change and National Security," *Environmental Forum* 33, no. 1 (January/February 2016): 49.
3. Marc Lallanilla, "What Is the Keeling Curve?" Live Science, 2 May 2013, http://www.livescience.com/29271-what-is-the-keeling-curve-carbon-dioxide.html; and Chris Mooney, "The Hockey Stick: The Most Controversial Chart in Science, Explained," *The Atlantic*, 10 May 2013, http://www.theatlantic.com/technology/archive/2013/05/the-hockey-stick-the-most-controversial-chart-in-science-explained/275753/.
4. For excellent detailed summaries, see especially the work of Spencer R. Weart at the American Institute of Physics (AIP). Weart's pathbreaking historical summaries are found in his book, *The Discovery of Global Warming* (Cambridge, MA: Harvard University Press, 2008), and in his continuing topical histories and timelines posted at https://www.aip.org/history/climate/; James Rodger Fleming, *Historical Perspectives on Climate Change* (New York: Oxford University Press, 1998), offers valuable insight into the

pre-1970 period. Other detailed histories include Anthony N. Penna, *The Human Footprint: A Global Environmental History* (Chichester, UK: John Wiley & Sons, 2014). There are also several very good, shorter overviews of the issue and the history of climate change; see, especially, Mark Maslin, *Global Warming: A Very Short Introduction* (New York: Oxford University Press, 2009); David Archer, *The Long Thaw: How Humans Are Changing the Next 100,000 Years of Earth's Climate* (Princeton, NJ: Princeton University Press, 2009); and Bill McKibben, ed., *The Global Warming Reader: A Century of Writing about Climate Change* (New York: Penguin Books, 2012).

5. See Richard E. Neustadt and Ernest R. May, *Thinking in Time: The Uses of History for Decision Makers* (New York: Simon & Schuster, 1986).
6. Study of Man's Impact on Climate at Massachusetts Institute of Technology (MIT), ed., *Inadvertent Climate Modification: Report of the Study of Man's Impact on Climate* (Cambridge, MA: MIT Press, 1971).
7. A short, helpful summary regarding terminology is provided by the National Aeronautical and Space Administration (NASA) in "What's in a Name? Global Warming vs. Climate Change," https://pmm.pps.eosdis.nasa.gov/education/articles/whats-name-global-warming-vs-climate-change. See also Leo Hickman, "Is It Time to Retire the Term 'Global Warming'?," *Environment* (blog), *Guardian*, 5 August 2010, http://www.theguardian.com/environment/blog/2010/aug/05/global-warming-birthday-new-name.
8. Wallace S. Broecker, "Climatic Change: Are We on the Brink of a Pronounced Global Warming?," *Science* 189, no. 4201 (8 August 1975): 460–63, doi:10.1126/science.189.4201.460.
9. *An Inconvenient Truth* did unquestionably have a great impact on publicizing the discovery and urgency of long-held findings. See the "script" as issued in Al Gore, *An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do about It* (New York: Rodale Books, 2006).
10. For a short discussion of Fourier as a pioneer, see Weart, *The Discovery of Global Warming*, 2–3.
11. For an entertaining and instructive history of the work of Agassiz and his colleagues, see Edmund Blair Bolles, *The Ice Finders: How a Poet, a Professor, and a Politician Discovered the Ice Age* (Washington, DC: Counterpoint, 1999).
12. A concise summary of Tyndall's contributions is in Mike Hulme, *Why We Disagree about Climate Change: Understanding Controversy, Inaction and Opportunity* (New York: Cambridge University Press, 2009), 43–45.
13. The crucial Arrhenius paper is "On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground," *Philosophical Magazine* and *Journal of Science*, series 5, vol. 41, no. 251 (April 1896): 237–76, which was based on work he did in 1895.
14. The First Vatican Council of 1869–70, led by Pope Pius IX, actively opposed any teaching of evolution. This was not modified until the second half of the twentieth century and no papal encyclical dealt with climate change prior to the recent *Laudato si'* (On Care for Our Common Home) issued by Pope Francis, who took up the issue of climate change in 2015.
15. Better weather forecasting received a great boost from post-mortems after the path of New England's catastrophic 1938 "Long Island Express" hurricane, which was not sufficiently predicted. A second tremendous driver was the military need for accurate measurements of weather and climate variables in WWII and in the subsequent Cold War.
16. During the late nineteenth century, boosters in arid states such as Kansas argued that the furrows that farmers made during plowing released moisture into the atmosphere that would then be returned to Earth as rain. This was a pseudoscientific claim used to sell land and attract settlers, coinciding with a moment when states west of the 100th parallel happened to have a period of greater than normal rainfall. In addition to the professionalization of meteorology and agricultural science, the Dust Bowl of the 1930s played a major, if unwelcome, role in laying the myth to rest.

17. Hulme, *Why We Disagree about Climate Change*, 53; G. S. Callendar, "The Artificial Production of Carbon Dioxide and Its Influence on Temperature," *Quarterly Journal of the Royal Meteorological Society* 64, no. 275 (1938): 233–40, doi:10.1002/qj.49706427503.
18. Fleming, *Historical Perspectives on Climate Change*, 107.
19. Callendar continued his CO_2 studies and advocacy for more than two decades, although his projected treatise on the subject never became a reality; see James Rodger Fleming, *The Callendar Effect: The Life and Work of Guy Stewart Callendar (1898–1964), the Scientist Who Established the Carbon Dioxide Theory of Climate Change* (Boston: American Meteorological Society, 2007), 65–87.
20. In addition to the military, the Atomic Energy Commission and National Science Foundation ultimately provided research funds that were applied to the investigation of global warming issues.
21. Weart, *The Discovery of Global Warming*, 22–37.
22. For one of the key papers reporting the data gathered by the Keeling team, see Charles D. Keeling et al., "Atmospheric Carbon Dioxide Variations at Mauna Loa Observatory, Hawaii," *Tellus* 28, no. 6 (December 1976): 538–51, doi:10.1111/j.2153-3490.1976.tb00701.x.
23. See Weart, *The Discovery of Global Warming*, 22–37; and Weart's more in-depth study of Revelle's work at https://www.aip.org/history/climate/Revelle.htm.
24. Weart in the above-noted works, especially, has underscored the ironic and unfortunate effect of repeat recommendations for "further study" of the threat of climate change without taking any positive actions.
25. The rising distrust of big government and big science in the wake of traumatic national events, such as the Vietnam War, the failure of the War on Poverty, and Watergate, is ably covered in a single text in William H. Chafe's *The Unfinished Journey: America Since World War II*, 7th ed. (Oxford: Oxford University Press, 2010).
26. An excellent short guide to the "ozone hole" effort, as well as to the IPCC and many other facets of climate change issue history, is Robert Henson, *The Thinking Person's Guide to Climate Change* (Boston: American Meteorological Society, 2014).
27. These included the international Global Atmospheric Research Program set up in 1967.
28. The National Service Center for Environmental Publications is available at http://www.epa.gov/nscep. Figures current as of search performed on 26 September 2016.
29. Marcia L. Wilson, Laura R. Jones, and Carol J. Kuhlman, *Future Environmental Problems: An Overview of Underlying Trends* (McLean, VA: Mitre Corporation, 1980), 23.
30. See Russell E. Train, "A Perspective on World Environmental Problems," *EPA Journal* 11, no. 1 (January/February 1985): 2–3.
31. See Philip Shabecoff, "Global Warming Has Begun, Expert Tells Senate," *New York Times*, 24 June 1988, http://www.nytimes.com/1988/06/24/us/global-warming-has-begun-expert-tells-senate.html.
32. See "The Public and Climate Change," Discovery of Global Warming, February 2014, https://www.aip.org/history/climate/public.htm.
33. The public opinion findings from the 1980s to 2007 are summarized in Matthew C. Nisbet and Teresa Myers, "The Polls—Trends: Twenty Years of Public Opinion about Global Warming," *Public Opinion Quarterly* 71, no. 3 (Fall 2007): 444–70, doi:10.1093/poq/nfm031.
34. See Meg Jacobs, *Panic at the Pump: The Energy Crisis and the Transformation of American Politics in the 1970s* (New York: Hill & Wang, 2016), 312.
35. Joshua P. Howe, *Behind the Curve: Science and the Politics of Global Warming* (Seattle: University of Washington Press, 2014), 187–88.
36. Al Gore, *Earth in the Balance: Ecology and the Human Spirit* (New York: Plume, 1993).
37. David de Rothschild, *The Live Earth Global Warming Survival Handbook: 77 Essential Skills to Stop Climate Change—Or Live Through It* (New York: Live Earth, 2007), 35, 44–45, 126–27, 148–53.
38. The "hockey stick" curve, presented by Mann, Bradley, and Hughes in their benchmark 1998 article, represented a significant example of climate change science moving

ahead with valuable work in the mid-1990s. See Michael E. Mann, Raymond S. Bradley, and Malcom K. Hughes, "Global-scale Temperature Patterns and Climate Forcing over the Past Six Centuries," *Nature* 392 (23 April 1998): 779–87, doi:10.1038/33859.

39. Peter Schwartz and Doug Randall, "An Abrupt Climate Change Scenario and Its Implications for United States National Security," reprinted in McKibben, ed., *The Global Warming Reader*, 318–49.
40. The 1990 act set up the U.S. Global Change Research Program, which still provides the basic general framework for much U.S. action and issues an annual report, *Our Changing Planet*, summarizing latest developments. The Global Change Research Act of 1990, Pub. L. No. 101-606 (1990). DOD Directive 4715.21, Climate Change Adaptation and Resilience (14 January 2016).
41. The Paris Agreement of December 2015, due to enter into force in 2020, as the European Commission stated, involved a binding pledge made by 195 countries to "a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to well below 2°C." See "Paris Agreement," European Commission, Climate Action, http://ec.europa.eu/clima/policies/international/negotiations/paris/index_en.htm; the IPCC website also includes a handy timeline of IPCC history. In recent years, IPCC has issued concise summaries for policy makers in addition to its traditionally voluminous and detailed assessment and panel reports. See IPCC, www.ipcc.ch.
42. See for instance, the 23 June 2005 letter of Representative Joe L. Barton to scientist Michael Mann, cited in David Ignatius, "A Bid to Chill Thinking," *Washington Post*, 22 July 2005, http://www.washingtonpost.com/wp-dyn/content/article/2005/07/21/AR2005072102186.html?utm_term=.69a1282eb98e.

Tooth-to-Tail Greening
Energy and Climate Leadership and Policy Change at the Department of Defense

Rebecca Pincus

Abstract: For decades, the U.S. government, in particular the Department of Defense (DOD), has struggled with the consequences of modern fuel-intensive military platforms. As awareness of climate change emerged at the end of the twentieth century, this environmental concern was added to such longstanding issues as fluctuating costs. This article examines a modern effort to reduce fuel consumption, and thereby climate impacts, through the congressionally mandated office of Operational Energy (OE). The creation and function of OE is reviewed and placed in context. It is argued that the strategy behind this office is markedly different than earlier "greening" efforts and significantly more aligned with the organizational culture of the DOD—and therefore more likely to effect institutional change.

Keywords: climate, energy, carbon footprint, security, military, green fleet, organizational culture, policy process

The 2008 election of Barack H. Obama marked a significant shift in American leadership on the issue of climate change. While his predecessor, President George W. Bush, had spoken out on the need to address the threat of global warming in 2001, 2002, and 2008, and launched programs to reduce air pollution and climate change, his Clear Skies and global climate

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change initiatives were widely perceived as failing to meaningfully address the scale of the climate change problem. President Bush's two terms have been described as an "eight-year sleep" on the issue of climate, which seems ever more apparent because of President Obama's initiatives.[1]

In 2008, as a presidential candidate, Obama had campaigned under the overall theme of change, which included engagement on climate, and he entered office with a clear intention to address the issue, including discussing his commitment to action in his 2009 inaugural address.[2] His commitment to tackling climate change was demonstrated by the establishment of the Interagency Climate Change Adaptation Task Force in 2009. Moreover, Obama then presented a more comprehensive approach to the issue in the 2013 *President's Climate Action Plan*.[3] While U.S. presidents have power over the executive branch, and can thereby influence federal agency behavior, Congress wields significant influence through its appropriations power. Congress, therefore, is able to participate in the formation of climate and energy policy, and affect the implementation of presidential initiatives.[4] These are obvious distinctions within the federal system, yet implementing policy is more than just orders and funding. The agencies that receive policy direction also, in turn, add to the direction of policy in the process of implementation.

Engagement with the causes and consequences of climate change varied across the Bush and Obama administrations as well as across Congress, yet the Department of Defense (DOD) is a significant stakeholder and an important actor in this policy evolution. As the largest federal agency, the most trusted American public institution, the largest U.S. fuel consumer, and an emitter of CO_2 on par with small countries, the DOD was, and remains, a key variable in any efforts to engage effectively with either the causes or consequences of global climate change.[5] This article will address efforts by both presidents and Congress to push the DOD to grapple with climate change and energy consumption.

In particular, this article will explore the emergence of an unusual approach to solving the complex set of problems associated with the climate-energy nexus, especially the establishment of Operational Energy (OE) within the Office of the Secretary of Defense at the Pentagon. The use of the term "climate-energy nexus" here refers to the increase in carbon dioxide and other heat-trapping gases in the earth's atmosphere produced by the combustion of carbon-based fuels, such as coal, petroleum, and natural gas. Any attempt to reduce atmospheric CO_2—and, thereby, decrease the likelihood of harmful climate change—will be centered around the current global dependence on carbon fuels, hence the "nexus." While efforts to reduce the intensity of fuel consumption at the DOD began during the energy crisis of the 1970s, and reappeared in the greening era of the 1990s, the OE office is unusual in

its climate-last approach to the climate-energy nexus.[6] Rather than framing its challenge as primarily environmental, and focusing on climate change (or alternatively focusing on cost as in the 1970s), the OE office frames its work in terms of mission benefits flowing from reduced fuel intensity.

While a variety of policy efforts had, and continue, to push the DOD to engage with the effects of climate change on the modern threat environment and to dial back the intensity of carbon fuel use in installations, DOD operations had long been protected from environmentally minded legislation of any stripe per national security exemptions. In contrast, the OE office was established to focus on the operational improvements to mission outcomes that could be achieved through reductions in carbon fuel intensity. After a review of climate and energy efforts by President Obama and Congress, the genesis of the OE office will be explored, and the effectiveness of its approach to organizational change will be considered. With this in mind, it is clear that while external forces, such as the efforts emanating from the executive office and Congress, instigated change at the DOD, internal forces within that agency, were as important, if not more, to bringing climate change policy to various military Service branches on the operational level. It is further argued that the novel approach of the OE office to the complex climate-energy challenge has produced important mission benefits while effectively reframing the question of DOD engagement with climate change. This highly effective strategy reflects a keen sense of DOD and military organizational culture. It is clear that external forces, in particular the Congress and president (after 2009), forced a degree of change; yet, internal forces were equally, if not more, important in enacting meaningful change at the operational level within the Services.

Presidential Leadership

On 5 October 2009, Obama issued Executive Order (EO) 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, that directed all federal agencies (including the DOD) to set and pursue sustainability goals. Agencies were then required to find ways to reduce greenhouse gas emissions, petroleum consumption, waste production, and water consumption as wells as identify other sustainable practices. Of course, Obama's order did not apply to the operational side of DOD business, which includes "combat support, combat service support, tactical or relief operations, or training for such operations." Beyond EO 13514, in 2013, the president also directed federal agencies to purchase 20 percent of their energy needs in the form of renewable sources by 2020.[7] Leadership by President Obama on the issue placed some pressure on DOD leaders to address climate and energy issues, although most specific mandates focused on installation energy and systems shoreside. Strategic guid-

ance, such as the *National Security Strategy* (NSS), did not strongly emphasize a military role in responding to climate change.

Despite any caveats, President Obama brought sweeping change from the executive branch to the Pentagon regarding climate change policy. While Secretary of Defense Robert M. Gates, who had been appointed by President Bush in 2006, stayed in office under Obama, new appointments arrived and were tasked to carry out Obama's initiatives. In particular, the new president appointed Raymond E. "Ray" Mabus to be the secretary of the Navy early in 2009. Mabus, previously serving as governor of Mississippi (1988–92) and ambassador to the Kingdom of Saudi Arabia (1994–96), is now the longest-serving secretary of the Navy since World War I and is considered responsible for the concept and drive behind the Navy's green fleet. He has been instrumental in the assimilation of Obama's climate change policies into the DOD.[8] With a career in business, and firsthand experience of the complexities and compromises inherent in U.S. energy policy overseas, it is perhaps unsurprising that one of Secretary Mabus's key policy priorities has been reducing the dependence of the Navy and Marine Corps on petroleum. In particular, Mabus has been a highly visible and vocal proponent of the "Great Green Fleet" and associated biofuels programs aimed at replacing the Navy's use of petroleum fuels. Overall, Mabus has brought both change and controversy to the DOD, yet for those interested in climate change policy, his influence is important to understanding actual implementation of Obama's policies.[9]

Before Mabus's green fleet received the most recent criticisms over costs, Obama's administration telegraphed its understanding of climate change as a security threat in its first NSS issued in 2010. Identifying climate change as the first of "key global challenges," the administration through the NSS called for action on reducing carbon emissions by cutting energy waste and adding renewable sources. In addition, the NSS flagged "new conflicts over refugees and resources" that will flow from climate disruptions as a major concern for the military, building an explicit connection between climate change and warfighting.[10]

Congressional Leadership

While President Obama provided highly visible leadership on the broader issue of climate change, congressional leadership had been crucial to enacting meaningful change in several key policy areas, beginning during the latter part of the Bush administration. The president, as commander in chief, is the ultimate decision maker at DOD, yet Congress plays an important role in shaping defense policy through writing legislation, providing budget allocations, and holding hearings. The following section examines congressional leadership in

the climate-energy nexus through the annual defense appropriations bill—the National Defense Authorization Act (NDAA)—that provides budget-based prescriptions and other mandates to the DOD. Over the course of four NDAAs (2007, 2008, 2009, and 2010), Congress forced the DOD to engage with climate change primarily along two tracks: (1) climate change as a factor shaping the external threat environment in which U.S. forces operate; and (2) as a consequence of carbon-fuel consumption intensity by both operational forces and DOD installations. An important third track of policy, however, emerged in the 2009 NDAA, which opened a new front in the effort to push DOD engagement with the climate-energy nexus. Rather than a "climate-first" approach, congressmen wrote into parts of the NDAA an "energy-first" approach that forced the DOD's leadership to rethink the agency's energy behavior for strategic reasons without any mention of climate change. Nonetheless, through the various NDAAs, Congress demanded the DOD attend to both climate and energy as separate or combined issues.

Climate Change and the Modern Threat Environment

The 2008 NDAA contained language specifically directing the DOD to incorporate climate change into its *Quadrennial Defense Review* (QDR) and national security and defense strategies. Specifically, military planners were tasked with assessing the risks posed by climate change to DOD missions and the security of the United States. This language is attributed to the efforts of Senators John W. Warner and Hillary Rodham Clinton. The 2008 NDAA drew media attention for its requirement that the DOD consider the effects of climate change on "facilities, capabilities, and missions."[11] This mandate was confined to the national security and national defense strategies and required the following QDR to consider the impact of climate change on DOD missions and capabilities.

The 2008 NDAA language mandating consideration of climate change resulted in the first appearance of that term in the 2010 QDR, which included a section on "Crafting a strategic approach to climate and energy." Across nearly four pages, the section noted the changes to the physical environment triggered by a changing climate and acknowledged that these changes will shape the DOD's "operating environment, roles, and missions." In addition, the QDR emphasized effects of climate change on DOD installations, in particular low-lying coastal installations susceptible to harm from rising sea levels.[12] Thus, the leadership via the QDR attempted to link climate change to real, physical threats that would require a response by the DOD generally and the military more specifically. Through this language, the QDR reflected a moderated focus on the effects of climate change on the future threat environment as well as a very practical concern about the potential effects on valuable DOD property.

For example, Naval Station Norfolk, Virginia, is considered highly vulnerable to coastal flooding under most climate change scenarios.[13]

Climate Change and DOD Energy Intensity

Fuel is like oxygen to the modern military; any deprivation reduces effectiveness and may be quickly fatal. Much of U.S. grand strategy during the last century has centered on securing access to, and secure transport of, this key strategic material. During times of crises, as in the mid-1970s, the intensity—or efficiency of use—of fuel has been a subject of focus among military policy makers. An easy means, however, of improving the speed and power of a jet, or increasing the armor of a tank, is to feed its engine more fuel more quickly, increasing its energy intensity. Military platforms designed with acceleration, speed, maneuverability, or heavy armor in mind generally are not fuel-sipping machines. The apparent tradeoff between efficiency and effectiveness has meant regular focus on energy intensity topics in key national security and military documents. Therefore, sections on energy in the behemoth-size document that is the NDAA were not new. These provisions, however, generally were small in scope and addressed more limited energy-efficiency goals. For example, the 2008 NDAA contained language in Subtitle D, the energy security section, defining an alternatively fueled vehicle, providing for the use of energy efficient fixtures and bulbs, and requiring reporting on the use of renewable energy sources. Earlier NDAAs contained similar provisions.[14]

"Energy-First": The Operational Energy Concept

A substantive shift occurred with the passage of the 2009 NDAA.[15] The sections on energy security contained new provisions and a dramatically broadened scope. While primarily focusing on new studies and reporting, this NDAA contained the kernel of what was to become a significant strategy for those seeking to reduce DOD consumption of petroleum. Congress ordered reports on operational energy management and strategy, the use of a fuel efficiency parameter in acquisition, the feasibility of using solar and wind energy to support expeditionary forces, the use of alternative and synthetic fuels by military users, and the risks of extended power outages posed by the aging U.S. grid. While climate change was not included in this section, the clear focus on reducing petroleum fuel use connected this legislative requirement to the climate-energy nexus through a surprising energy-first approach that left climate benefits of reduced fuel use unmentioned.[16]

These reports and studies ordered by Congress, per the 2009 legislation, pointed in interesting directions and marked a key departure from existing baselines regarding the externally driven engagement on climate-energy issues

by the DOD. Three notable lines of effort emerged in the 2009 NDAA that marked a significant change in policy. First, the concept of "operational energy" was introduced and defined as "the energy required for training, moving, and sustaining military forces and weapons platforms for military operations. The term includes energy used by tactical power systems and generators and weapons platforms."[17] This new concept was given teeth by the following subsection, which connected the concept of operational energy to the beating heart of the military organization—the acquisition process. Second, by requiring the secretary of defense to develop and implement a fuel efficiency key performance parameter (KPP), the NDAA legislation opened a second potentially highly effective leverage point. KPPs are used early in the acquisition process, when an agency is developing the requirements for a given system. KPPs set markers out for the type of characteristics a system should contain, and defense industries are very attentive to these early signals of intent. The direction to develop a fuel efficiency KPP therefore created space to assess acquisitions on their fuel efficiency. Third, the NDAA's subsection requiring a study on the feasibility of solar and wind energy to support expeditionary forces contained language that had great potential for a powerful effect on future implementation efforts. The secretary of defense was directed to study the potential of these alternative fuels "to reduce the fuel supply needed to provide electricity for expeditionary forces *and the extent to which such reduction will decrease the risk of casualties by reducing the number of convoys needed to supply fuel to forward operating locations*."[18] The origin and purpose of this important language will be addressed in later sections of this article, but clearly, the legislators' choice of words was moving the DOD toward adopting greener techniques even in areas previously excluded due to readiness concerns.

In addition to the subsections discussed above, Congress also used the 2009 NDAA as a legislative tool to establish the position of director of operational energy, plans, and programs answering to the secretary and deputy secretaries within the Office of the Secretary of Defense (OSD).[19] Furthermore, each Service secretary was directed to designate a senior official responsible for operational energy for that Service, to coordinate with the new director of OE, and to implement initiatives pursuant to the operational energy strategy.[20] According to one individual involved with the OE office, it was "not a particularly wanted office." Therefore, it is perhaps not surprising that Section 902 was mentioned in an accompanying signing statement by President George W. Bush, which stated that 902 was among four sections that "purport to impose requirements that could inhibit the president's ability to carry out his constitutional obligation."[21]

The 2009 NDAA operational energy initiative was hinted at in the 2007 NDAA, when legislators during Bush's last term set the policy of the DOD

"to improve the fuel efficiency of weapons platforms, consistent with mission requirements" and ordered a report to study the feasibility of designating a senior DOD official to implement this policy.[22] The limitations, however, of this earlier language are clear. Later bills, in particular the 2009 and 2010 NDAAs, contained much more specific direction with clearer measures for accountability. The 2010 act also contained a section under Title III, Operation and Maintenance (O&M) funds: "energy security."[23] The sections contained here appropriated funds for a director of OE, and directed other funding and reporting on energy efficiency programs, fuel demand management, and the use of renewable fuels. Language from the influential 2009 NDAA also made its way into the 2010 QDR: "Energy efficiency can serve as a force multiplier, because it increases the range and endurance of forces in the field and can reduce the number of combat forces diverted to protect energy supply lines, which are vulnerable to both asymmetric and conventional attacks and disruptions."[24] This sentence echoes the crucial idea, that reductions in energy use could benefit military operations, that appeared in the 2009 NDAA. The 2010 QDR went on to cite many of the actions resulting from the 2009 NDAA, such as the creation of an energy efficiency KPP and appointment of a director of OE.

Congress on Climate Change and the DOD

The preceding sections point to a significant effort from Congress to push the DOD to engage with both the causes and consequences of climate change over multiple budget cycles. By using the NDAA as a vehicle, congressional leaders placed the issue squarely on the table, imposing new requirements on the DOD and forcing direct change. The extent of the change implemented, and the degree to which compliance would be meaningful through culture change, cannot be determined simply from statutory language. Nevertheless, congressional lawmaking, accompanied by presidential efforts, can be understood as part of the process by which the DOD engaged with the causes and consequences of climate change. An important piece of the efforts noted above was the creation of the OE office at the DOD (in OSD), and the creation of a director for that office. Using this policy change as a case study, the following sections will explore the implementation of this change at the DOD.

An Inside View of Progress on Energy and Emissions

The preceding sections illustrate the significant "pushing" that came from Congress and the president to force change at the DOD on issues of climate change and energy. Internal efforts, however, also contributed to moving climate change and energy issues onto the DOD agenda. These efforts predated the Obama administration and even the 2008 NDAA that contained significant climate-related mandates from Congress. In fact, internal efforts to draw atten-

tion to the complex costs of petroleum in the DOD are a long-standing phenomenon that evolved dramatically around the turn of the twenty-first century. While some of this internal impetus grew out of environmental issue communities, the effort appears to have been primarily motivated by recognition of the operational costs of a heavy logistics burden on U.S. forces. The following section will analyze how the members of policy community in the DOD were able to leverage political events as a "policy window" that led to the 2009 and 2010 NDAAs.

To understand how policy makers were able to lay the groundwork for the 2009–10 legislation, we will use John W. Kingdon's policy window model, adapted and compressed to suit the case study at hand and the constraints of space. Kingdon conceptualizes the policy process by categorizing key players as "streams" and "entrepreneurs" and action in conjunction with temporal issues, or "policy windows." In the most basic terms, policy problems exist and are studied by specialized communities inside and outside of government in ongoing *streams* and that these problems can suddenly come to the public attention through crises or by focusing events that briefly open a *policy window* for action. Also important to the process, *policy entrepreneurs* can connect these streams during windows to bring about policy change. While possibly oversimplified, using Kingdon's model provides insight into how climate change and energy security topics came squarely within the DOD's purview, in particular, to the creation of the OE office after the passage of the 2009 and 2010 NDAAs.

Policy Streams: DOD Concerns about Fuel Costs

Using this analytic framework, it is possible to understand the 2009 and 2010 NDAAs as the outcome, rather than the beginning, of long-standing efforts to address the climate-energy nexus at the DOD.[25] The following section will explore the long buildup to the 2009 and 2010 NDAAs, and argue that the novel language and initiatives contained in this legislation resulted from years of action in the policy community that laid the foundation.

In particular, two reports from the Defense Science Board (DSB) provided early arguments for focusing on fuel efficiency as a path toward improved warfighting. In 2001, the first of these DSB reports was released. With an awkward title, *More Capable Warfighting through Reduced Fuel Burden*, it landed in May 2001, just a few months before the terror attacks of 11 September. In the wake of the 9/11 attacks, there was no time to focus on fuel efficiency. Nevertheless, the 2001 report laid out early markers that clearly informed later legislative developments and the work of the OE office. For example, the 2001 DSB report emphasized the "significant warfighting, logistics and cost benefits" of greater fuel efficiency. It also pointed directly to failures in the acquisition

and maintenance systems that masked the importance of fuel efficiency. Two points of failure in particular were noted: (1) by pricing fuel on wholesale refinery costs (at point of purchase) rather than calculating point of delivery costs (in-theater), the actual "end-to-end" cost of fuel remained hidden; and (2) fuel efficiency is neither factored into acquisition (through requirements) nor considered in performance assessments (through allocation processes). The 2001 report advocated for changes in these key systems to bring greater attention to the question of fuel efficiency, and argued that such attention would quickly drive the adoption of more efficient technologies into current and future DOD systems. While reducing the fuel burden of operational forces would sharply reduce the carbon footprint of the DOD, the DSB report did not use this argument or employ environmentally motivated factors, focusing entirely on the cost-saving and operational benefits of fuel efficiency.[26]

Opening the Policy Window: Americans See the New Costs of Fuel

The wars in Iraq and Afghanistan, with their heavy casualty tolls from fuel convoy attacks, served as focusing events that opened policy space for reform. While the 2001 DSB report was overtaken by current events that focused public attention on terrorism, the fighting in Iraq and Afghanistan soon brought the spotlight back to fuel security. The frequency of attacks on U.S. fuel convoys provided a dramatic and highly visible human argument for reducing fuel consumption, which was made across media outlets as well as in policy circles. Marine Corps Lieutenant General James N. Mattis, commanding general of the 1st Marine Division in Iraq, telegraphed the message: "Unleash us from the tether of fuel."[27]

There were good reasons for Mattis's comment, and the media heavily covered convoy attacks. The reporters at the *Los Angeles Times* covered the story of Keith M. "Matt" Maupin in detail, a soldier killed during a convoy attack, casting light on the fuel supply problem in Iraq, including the use of contractors. Robert Bryce at *The Atlantic* highlighted the challenging nature of the problem. Insurgent use of improvised explosive devices (IEDs) led to increases in vehicle armor, which decreased fuel efficiency and required more fuel convoys—opening additional opportunities for IED attacks.[28] As Dexter Filkins wrote in the *New York Times* in 2003, in Iraq, "the effort to supply American fighters at the front could be a battle itself." Filkins noted that "the voraciousness of the modern military" meant that a 300-vehicle fuel and ammunition convoy carried only a few days' supply, and constant attacks on convoys meant "a lot more fighting than [the U.S. military] bargained for."[29] Media coverage of convoy attacks served to focus public and policy-maker attention on the issue of operational energy use and spurred policy change.

Joining the Streams: Policy Entrepreneurs and Enacting Change

In 2001, when the DSB issued its report, the policy window was not yet open, and could not be opened without the influence of policy entrepreneurs who could take advantage of their unique positions. Unearthing the significance of their actions and leadership is difficult using traditional sources due to the nature of the DOD employment structure as well as confidentiality. Thus, the author conducted a series of interviews to bring to light a greater understanding of the workings of the DOD generally and OE specifically. According to interviews done in 2013–14, the 2001 report generated only "mild interest."[30] One of the interviewees, who at the time was a leading actor in DOD energy security issues, claimed responsibility for reviving the 2001 DSB report, by bringing it to light once again in 2006. According to this respondent, he discovered the report "sitting on the shelf" and called DSB to inquire about an update.[31] This effort began in 2006, coinciding with the chartering of the DOD Energy Security Task Force, led by the DOD's Acquisition, Technology, and Logistics (AT&L) office.

The second DSB report, with the attention-grabbing title *More Fight—Less Fuel*, was published in February 2008.[32] Given the media climate that had focused scrutiny on fuel convoy attacks, this report received widespread attention. The relatively small number of individuals involved points to the existence of a tight policy community and specific policy entrepreneurs who played key roles in spearheading change.

The 2008 DSB report contains language and arguments that appear to be templates for the 2009 and 2010 NDAAs. While outright lobbying by DOD employees is not permitted, it appears that the work of key policy entrepreneurs was effective in translating the expert recommendations of the policy community, contained in the 2008 DSB report, into actual legislation. Through this process, meaningful and substantive change was enacted. While this process took several years, and increasingly specific and forceful statutory language from Congress, it appears to be an example of collaborative work to create change within the large and complex DOD organization.

The policy community was not by any means confined to the DOD. Academic experts produced work arguing for reduced fuel use by the military housed under the DOD. The military community, in particular retired leaders, weighed in forcefully, using their access to media and their ability to influence opinion. In 2007, a group of retired generals and admirals issued a report through CNA's Military Advisory Board titled *National Security and the Threat of Climate Change* that argued forcefully for climate-energy-security connections.[33]

Several key players in the policy community around the climate-energy nexus, who can be considered policy entrepreneurs in the Kingdon model, had roots in earlier generations of environmental policy problems at DOD. These

connections appeared in the interviews conducted by the author. Respondents with extensive experience linked climate and energy efforts to earlier generations of institutional change at DOD. The line reached back to ozone; key individuals were working on ozone-related issues, which allowed for an easy transition into other environmental issues, such as base cleanup. In addition, ozone had an operational component, since some weapons-related chemicals contained ozone-harming components. Ozone, therefore, provided an early experience for key individuals, who developed an understanding that the ways DOD behavior harmed the environment also harmed DOD operations and produced health impacts among DOD personnel. The DOD participated in the Kyoto, Japan, climate negotiations; according to one respondent, the U.S. delegation may have been the only team with a military component.[34] This respondent drew a line from the Kyoto negotiations in 1992 to the 2001 DSB report. Moreover, this informant argued that the failure of the Kyoto Protocol led DSB authors to hold the report until the arrival of a new administration in early 2001, hoping for a clearer path to implementation.[35]

This early phase of environmental interest in the DOD during the 1980s and 1990s centered around base cleanup, had produced an acrimonious and defensive relationship between employees in the DOD and the Environmental Protection Agency. The antipathy between the two agencies colored all environmental issues that came within their purview. The effects of litigation drove change in DOD behavior toward much more environmentally responsible directions.[36] Nonetheless, it created a defensive posture at DOD. As one respondent who had worked in DOD for several decades explained that the DOD's mission is not to be an environmental leader, "but [DOD] had to be on the forefront in order to protect our interests." The Pentagon had learned the hard way that "when you lose the NEPA [National Environmental Policy Act] suit," it "can be a mission stopper."[37] The DOD was "going to get litigated to death" and its leaders realized as an agency it had "got to get its act together."[38]

In addition, the high cost of base cleanup became a dynamic affecting budgetary gravity. Efforts to reduce pollution and clean up DOD activities were linked to human safety at the DOD under President Bush, and environmental safety and health issues also were prioritized during the Bill Clinton administration. As a result, early framing of these issues revolved around environmental and pollution concerns. This framing eased acceptance by military leadership wary of environmentalism: "they all understand that in order to be an effective military and to conduct military operations if called upon, people have to be healthy."[39] Environmental safety concerns, like pollution, which created health hazards to military personnel thereby were framed as impinging upon combat readiness and the ability to effectively complete the mission.[40] This framing echoes the current OE approach and may be considered a template.

Implementation Factors: The Unique DOD Environment

The DOD is a unique federal agency, and interviews are a useful source of data about the complex and often opaque rules that govern it. But due to issues of attribution and institutional hierarchies, it is difficult to get the views of DOD leadership on record, which, in turn, defeats interested outsiders from analyzing DOD operations. Considering that, as we have seen here, several, high-level external forces combined with internal forces to create change in the DOD, it is essential that we understand how actors internal to the DOD embraced, rejected, or instigated change within this context. Off-record interviews enable thick description of the lived experience of key participants in the history described, an ethnographic approach supported by the literature on organizational culture.[41] Headed by a presidential appointee, the secretary of defense, the DOD is comprised of the military Services (Army, Navy, Marines, and Air Force); along with members of the Joint Chiefs of Staff, who head the regional combatant commands; and the Office of the Secretary of Defense, which contains even more agencies (Defense Advanced Research Projects Agency, Defense Intelligence Agency, Defense Logistics Agency, etc.). The DOD is enormous: 1.3 million on active duty in the Services, 742,000 civilian personnel, with another 826,000 in National Guard and Reserve forces and more than 2 million retirees receiving benefits and services.[42] Given this tremendous scale, and the inefficiencies that inevitably accrete in large systems, it is not surprising that many interview respondents underlined the importance of leadership to policy change as well as a variety of other internally and externally defined limitations on action discussed below.

Leadership

Respondents repeatedly underscored the importance of leadership in driving change within the DOD. While leadership is not responsible for specific actions because DOD leaders, generally, are not implementing orders but rather delegating, leadership has "tremendous power" to shape the parameters of the discussion and set priorities on a particular topic.[43] "Leaders at the top can make a difference," noted one interviewee. Similarly, another noted that leadership can be especially influential when "the building," referring to the complex organization contained in the Pentagon, is not leaning toward the change mandated by the president, Congress, or internal actors. Conversely, leadership does not always create change. Some respondents expressed skepticism about top-down, "force-fed" implementation and the durability of such change.[44] Many respondents pointed specifically to Secretary Mabus's spearheading of Navy biofuels programs as an example of leadership driving change, but in a manner likely to be ephemeral and that will not persist after he leaves office.[45] Thus, the interplay of elected officials, and politically motivated appointees, Service rep-

resentatives, government service employees, and contractors can muddle the direction and source of leadership on such issues as climate change.

Requirements, Acquisitions, and Budgets

Moreover, as a part of these interviews, three "big processes" at DOD were identified as obstacles to change: requirements, acquisitions, and budget. As one respondent noted, "You are always fighting the people battle, [and] that's part of the budget battle."[46] It was important to get OE involved in these three big processes to create change. One respondent described how the Services initially had established OE "shops" in installations programs, which was the "wrong place" because those offices "knew nothing," and "had no interest, understanding, or influence in critical areas."[47] However, the OE office has recently been placed into an installations department at the DOD, although it is part of the broader AT&L office.[48] This finding—of the absolute importance of budgets and the flows of money—has been borne out by research into other areas of U.S. military organizational behavior by the author.

The DOD budgeting process frequently was discussed as affecting the conversation, and the budgetary system of the DOD created artificial pressures that result in inefficiencies. The DOD has an "infinite discount rate," which is worse during wartime, so money is hard to find for long-term payoffs, which, in turn, affects acquisitions.[49] The acquisitions process was described as "mind-numbingly complicated" and "extremely bureaucratic," designed primarily to avoid embarrassment.[50] As a result of public scandal relating to high-cost items, the acquisitions process was described as a defensive structure with rigid rules, which was very difficult to change or break into.[51] As one respondent explained, the acquisitions process is "not always guided by reason," but is "entirely fear-driven."[52] "You run into all kinds of acquisition-related problems," one respondent concluded. Acquisitions programs are "like glaciers moving downhill," remarked one respondent, and so it is easy to see how these internally and externally controlled mechanisms slow the pace of change within the DOD.[53]

Interviewees also placed blame on other processes. Respondents noted that, during war games, energy never runs out. As a result, questions regarding the sourcing, and the consequences thereof, of fuel left unattended creates inertia on the topic of energy: "it is going to take something bad to push that [energy] envelope," since there was a tendency to resist reworking a process that appeared not to be broken.[54] The sheer effectiveness of DOD logistics created unintentional resistance to reducing petroleum use, since operators were accustomed to always-available fuel, delivered by "the best logisticians in the world," doing "miraculous" work.[55] The work of these logisticians was not linked closely to planning, but part of a separate process, "engineering over the wall."[56] As a result, planners were able to assume the availability of fuel because

the logisticians made fuel a surmountable obstacle. As one respondent noted, the assumption was that "if I want fuel, I get it."[57] Attention to the problem of energy only came if there were problems in acquiring it: "I care if I can't get it."[58] Consequently, one respondent asked rhetorically, when it comes to logistics, "what is our success hiding?"[59]

Culture and Climate

Because acquisitions and logisticians made fuel available as needed to the Services, the climate-energy nexus received little attention. Yet cultural factors within the DOD played a role as well. According to a respondent involved in the second DSB report, climate was "not in the mix" when the report was written because the inclusion of this issue essentially would turn warfighters off. "If you're going to sell something in the building, it's got to be about warfighting."[60] It was important to avoid giving the impression that operational energy advocates believed that "saving energy is more important than going fast."[61]

Respondents underscored the unique culture of the military and the specific Services as well as perceptions that color their actions. The Army is "dumb," the Air Force is "devious," and the Navy is "defiant."[62] More important, as one respondent argued, each Service has preconceived notions about warfighting, driven by its missions and the platforms that it buys, and energy concerns needed to fit those platforms. In the Air Force, the fighter pilot and fighter jet is central to its mission; to the Army, the tank or the next ground combat system is of primary concern; and the Navy leadership generally looks to the next warship or carrier-based fighter; the Marines focus on the air-ground task force communication system.[63] Overall, respondents repeatedly underscored the importance of obtaining, not improving, weapons systems for the military: "If they [the DOD] only have a dollar to spend, they are going to spend it on a gun, not on making the gun better or easier to sustain," concluded one respondent.[64] The DOD is "disaggregated," with gaps between OSD and the Services, between the Services themselves, between combatant commands, and between bases. There is competition among DOD components as well: "Somebody's ox has got to get gored" when new priorities emerge, meaning one stakeholder often loses funding when another stakeholder has an urgent need.[65]

As each Service has longstanding culture, so does the DOD. The DOD, as an organization, is driven by "doctrine, policy, and SOP [standard operating procedure]."[66] A flurry of activity without institutionalization is seen many times at DOD, meaning that a new concept or focus may suddenly trend strongly, but would not generate institutional change and would therefore eventually wane and be forgotten.[67] At the Pentagon, there is a "warehouse full of lessons not learned," as one respondent stated, and a "warehouse of lessons unlearned," said another.[68] "People don't pay attention to history," remarked

another.[69] Respondents suggested that efforts to reduce DOD petroleum use began under President George H. W. Bush, were strongly pushed under the Clinton administration, and continued to some degree under President George W. Bush. Yet despite the length of the general effort, the episodic nature of attention and leadership on the topic produced little institutionalization. Issues of the day came and went, and each new emphasis brought efforts by many different stakeholders to link their particular work to the current issue du jour to boost attention and budget.[70] The broadness and malleability of "environment" made these waves of attention particularly vulnerable to linking and dispersion.

Insiders versus Outsiders

The division between DOD insiders and outside political appointees is significant in terms of how change is perceived and the value of that change. Respondents note both the obvious division between military and civilians and the differences between career civil service and political appointees. One noted, "Politics always trumps analysis."[71] Career civil service employees were essential to continuity, since they created and perpetuated institutional memory. In contrast, both military and political appointees rotated frequently. Political appointees "rotate fast and have their own agendas," while the "military guys are going to move on so you can't depend on them."[72]

Respondents with long-term Pentagon experience expressed concern about the effects of outsider pressure on energy and climate issues. As one insider put it, "Crusaders you always worried about," or "zealots," referring to the political appointees who dogmatically held to their agendas and pushed back when policies did not support their programs: "political appointees are where crusaders come from."[73] The OE office was "not a particularly wanted office."[74] Insiders could resist pressure through time-tested strategies: as one respondent said of Sharon Burke, the first assistant secretary of defense for OE, the DOD leadership would "yes her to death and slow-roll her."[75] Slow-rolling is a often used strategy that enables Service-loyal military players (as well as career civil servants) to stymie short-lived political appointees, and within that the long-term military people can often wait out the people holding more short-term political positions.

Criticism Emerges

Some criticism of the OE office emerged in interviews. "They don't have a clue," one respondent argued, suggesting that the OE office was hung up on day-to-day tasks.[76] The ability to resupply and provide maintenance on alternative energy systems was identified as a weakness that should have been solved by the office with the task of managing "operational energy."

The Energy/Environmental Security Theory Context

The sections above sketch out several different lines of effort, all advancing the incorporation of climate change and energy concerns within DOD activities. It is important to recognize and differentiate the subcomponents of this broad effort to assess motives and gauge effectiveness. Several axes exist: the divide between operational and nonoperational missions and systems; and the divide between the effects of climate change on DOD activities versus the effects of DOD activities on climate change.

The rapidity with which climate change was sucked into contemporary security discourse reflected the complexity and broadness of security studies in the twenty-first century, as well as the scale of the climate change problem itself. Scholarship on the connections between climate and security flourished to such an extent that one paper in 2010 queried if climate change was "The Hottest Issue in Security Studies?"[77] The new nature of warfare played a key role in emphasizing the role of energy in warfare. As one respondent described, the earlier generation of logistics relied on the "little ship in a big ocean" model, whereby logistics support to forward operators was protected from adversaries by the intrinsic nature of the spaces involved. In the modern era, adversaries are focusing primarily on soft targets, such as logistics, and employ more advanced technology. In addition, as energy intensity has increased, the logistics burden is larger, creating a bigger footprint and greater visibility.

Efforts to reduce the impacts of DOD activities on the environment, broadly speaking, date back to the 1970s. As climate change emerged on the policy agenda, it was included in efforts, generally led by the Democratic Party, to "green" the DOD.[78] These efforts were directed at the nonoperational side of DOD activities. Climate change poses a threat to DOD installations at home (and abroad), in particular those in low-lying coastal locations.[79] For example, Norfolk, Virginia; Camp Lejeune, North Carolina; and other sites are vulnerable to sea-level rise and flooding. The 2010 QDR, and associated efforts, were aimed at incorporating consideration of the impacts of climate change on DOD activities, and addressed both operational and nonoperational activities. Climate change may change the threat environment in which DOD missions emerge, for example, by increasing instability, compounding the factors that give rise to conflict and displacing people.

The connection between climate change and the modern security environment was made explicit in the 2010 QDR, but rode on a wave of scholarship that provided impetus and a supporting body of thought to propel new security assessments into the Pentagon. An early paper by Jon Barnett attempted to "systematically" lay out the range of security-related impacts of climate change.[80] Barnett included displacement of populations due to rising sea levels, increasing instability in fragile states where scarcity of food and water, along

with extreme weather and spreading disease, may contribute to conflict, and the stressful economic costs of climate adaptation in his list of security considerations. Later work by Barnett amplified and refined these arguments.[81]

Work by military scholars also provides insights to the connections between energy intensity, efficiency, and military effectiveness. Ryan Umstattd's work, for example, informed by his Air Force experience, is a helpful introduction to the complicated question of energy use at DOD. While providing a contemporary academic analysis that supported the QDR and NDAA efforts—highlighting the payoff from energy efficiency at DOD—Umstattd provided an historical analysis tracking DOD expenditures on energy, as well as patterns of consumption. He also noted the unique forces shaping DOD energy behavior: it is "in the business of delivering military effectiveness." Nevertheless, Umstattd held that military effectiveness is not necessarily sacrificed by pursuing energy efficiency. Stacy Closson provides similar analysis and a useful summary of policy evolution on the subject in a clear and accessible set of tables.[82]

Conclusions

Effecting institutional change in an organization as large, as powerful, and as unique as the Department of Defense always has been daunting. When it comes to unconventional security threats, such as climate change, the challenge is significant. The nexus between climate change and carbon-based fuels—the lifeblood of the modern military—makes attempts to engage with climate even more perilous. Earlier efforts to "green" the DOD have received mixed assessment, and respondents interviewed for this research reinforced this ambiguity by underscoring the negative reception given to environmentally focused policy efforts.[83] The focus here is on the Operational Energy office, which took a mission-first approach to inculcating organizational change relating to fuel and energy—and by extension, climate.

While producing the same outcomes—reducing petroleum use, increasing alternative energy use, shrinking DOD's carbon footprint, and boosting the development of alternative energy technology—the OE office was stood up on an entirely different premise than earlier generations of environmentally focused policy changes. The genesis for OE came from the in-theater liabilities of fuel dependence: attacks on fuel convoys, the need for refueling stops, and physical ties to supply depots.

OE is a special case. Military operations are protected from greening efforts due to their special national priority—the mission comes first. Therefore, greening efforts, including obligations to reduce the climate footprint of DOD activities, excluded operational activities. While climate change increasingly was incorporated into DOD activity, climate considerations did not reach to the operational side. Efforts to incorporate climate threats into DOD planning and

strategy took an entirely different approach to increasing awareness of climate change at the DOD. By emphasizing the threat posed by climate change, including the impact of climate change on conflict and insecurity abroad as well as the impact on DOD installations, this effort touched both operational and nonoperational sides of DOD.

Connecting the alternative energy idea to the tactical and strategic problem was the key insight of those advocating for operational energy. In this, the connection to "green" was a liability rather than a motivation. As one key leader in the office argued, "Pretend oil is free."[84] The vulnerability of supply lines is still a problem, because forces are diverted to protect vulnerable fuel supply lines. The smaller these supply lines can be shrunk, the fewer troops must be diverted from the primary mission. By framing petroleum use as a warfighting problem, and "solving military problems," the OE office kept the focus on operational effectiveness.[85] This argument, entirely devoid of problematic frames of environmentalism or cost-cutting, was a powerful insight that has refocused long-standing efforts into a more successful and organizationally well-aligned direction. By working within the established organizational culture of the DOD, which prioritizes the operational mission before all else, the strategy behind the OE office aligned with the organization rather than taking a disruptive approach. As one respondent put it, the DOD has a "culture of more mass"—the OE office may be changing this culture from tooth to tail with its novel focus on the "sustainability of the fight."[86] However, another respondent noted that "every system in the pipeline" is more energy-intensive than what is currently in use, underscoring the critical point that energy demand by the DOD in coming decades will continue to be a significant issue to both warfighting and climate change.[87]

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16. Ibid., Sections 331, 332, 333, 334, 335.
17. Ibid., III(D)(331)(a)(4).
18. Ibid., III(D)(333)(b)(1). Emphasis added by author.
19. Ibid., Section 902(a–c).
20. Ibid., Section 902(d)(2).
21. It should be noted that NDAAs are generally passed at the start of the federal fiscal year (October) for the following year. Therefore, the 2009 NDAA was signed by President Bush in the final months of his administration in late 2008. "Statement on Signing the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009," *Weekly Compilation of Presidential Documents* 44, no. 41 (20 October 2008), 1346.
22. John Warner National Defense Authorization Act for Fiscal Year 2007, Section 360.
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terviews were conducted in 2012–13. Interviews were conducted off the record to permit respondents to speak freely on sensitive political issues. Respondents' views were captured to the greatest extent possible through careful and detailed note taking during each session. Interviews were unstructured, and generally lasted one to three hours. A snowball approach was used to identify respondents. While the interviews were extensive, covering topics that included climate change, patterns of fuel use, including alternative fuels and the culture surrounding fuel, and organizational change within DOD, the following section will present information specific to this paper's main topic: the OE office.

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49. DOD interview, November 2013. For this discussion, the current moment is infinitely more important than the future; for example, in wartime, one would obviously choose 1 helicopter today rather than even 100 helicopters in 10 years.
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Impact of Climate Change on U.S. Military Operations in the Western Pacific

Ralph Espach, David Zvijac, and Ronald Filadelfo

Abstract: Climate change will dramatically affect many nations in the Asia-Pacific region. We assess that the region's climate-related challenges 30 years from now will be similar to those of today—storms, flooding, drought, agricultural stress—but with greater average frequency and intensity. The security lines of operation most likely to be affected are humanitarian assistance and disaster relief and theater security cooperation. The authors find that the U.S. military is well equipped for these operations, even if they occur with growing frequency and complexity. This article is based on a study CNA performed in 2015 for the Office of the Secretary of Defense.

Keywords: climate change, Asia-Pacific, humanitarian assistance, disaster relief, theater security cooperation, military outreach, USPACOM, Pacific Pathways, ASEAN, migration

In future decades, climate change will reduce freshwater, dry soils, melt glaciers and ice shelves, and intensify flooding, droughts, and storms in many regions of the world. Supplies of water, food, and energy will be affected, causing societal stress and instability. Countries where governments already struggle to provide basic services and protections to their populations will be sorely challenged to respond. Mass protests, rising crime rates, migration, and

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insurgency will be increasingly likely and widespread. In areas where poor governance overlaps with long-standing tensions, these additional stressors will raise the risks of political instability and violent conflict.[1] In its 2014 *Quadrennial Defense Review*, the U.S. Department of Defense (DOD) stated that the effects of climate change act as "threat multipliers that will aggravate stressors abroad such as poverty, environmental degradation, political instability, and social tensions," and that climate change "may increase the frequency, scale, and complexity of future missions."[2]

The full range of these impacts described by the DOD is expected in the Asia-Pacific region, where they will affect a population of more than 3 billion people. Since the region is also a dynamic and growing theater for U.S. military operations, consideration of how these climate change-driven impacts may affect those operations in the Asia-Pacific yields lessons that apply around the globe. This article is an effort to advance our understanding of those impacts, their likely effects during the next 30 years, and the implications for U.S. military policy, force structure, operations, and international cooperation in the Asia-Pacific theater. Understanding the ways in which climate change is likely to affect the demand for security assistance and operations in the Asia-Pacific will help the DOD predict and plan for contingencies and conflicts as well as train and equip U.S. and partner nation forces for realistic future scenarios of crisis and turmoil. Adapting to, planning for, and taking measures to prevent the worst climate change impacts as a community of partner nations can also be an area of collective risk management and cooperative response to shared security threats.

We will argue that, in general, DOD capabilities and assets in the Asia-Pacific are likely to be sufficient to support emergency response missions, even as these increase incrementally in frequency and intensity in the decades to come. Moreover, the DOD and its regional partners should incorporate rising likelihoods that sequences and overlap of such missions might simultaneously occur around the world, as well as the risks of missions in the Asia-Pacific requiring humanitarian assistance operations in the midst of social tensions and conflict. Later in the essay, we will discuss the rising importance for U.S. regional security interests of emerging powers as well as traditional allies, as we foresee that U.S. forces and assets will increasingly play support roles within regional and international coalitions. The degree to which the United States and China can cooperate on issues of regional environmental protection, adaptation to climate change effects, and humanitarian assistance will determine in large part the contours of the region's security cooperation in this area.

Climate Change Effects in the Asia-Pacific

While some consequences of climate change will result in political or financial responses, the focus of our investigation was the effects that are most likely

to create demands or requirements for response that potentially include security forces. Putting aside more extreme scenarios where military capabilities are used to help mitigate climate effects, such as launching substances into the atmosphere or oceans, we are concerned mostly with the effects to human systems and the resulting societal responses to those effects.

Expected Physical Changes

The fifth assessment report of the United Nation's Intergovernmental Panel on Climate Change (IPCC) documents likely climate change events that will have an impact on the Asia-Pacific region. Storm damage, drought, flood damage, and water and food scarcity are anticipated outcomes for countries in the Asia-Pacific due to climate change.[3] Although, over the long run, sea-level rise poses a staggering threat to coastal populations and infrastructure across the Asia-Pacific, we exclude it from our analysis because its impacts are not likely to be dramatic during the 30-year time horizon. Because of the larger global changes, nations in the Asia-Pacific will see, as other nations have, extreme weather events. Storms will, therefore, cause more damage in the future. The current state of science is unclear about the future frequency of typhoons and cyclones, and scientists are cautious to predict their numbers. The intensity of these storms, however, is expected to increase with warmer sea-surface temperatures.[4] Flooding, already a relatively common problem across the Asia-Pacific, is expected to grow more intense and frequent during the next 30 years.[5] Several factors will contribute to the intensity and timing of floods, including more volatile precipitation patterns and glacial melt, which may increase the variability of flow rates in many of the region's major river systems.

In contrast to the effects of water damage, rising global average temperatures will almost certainly produce increasingly frequent and more intense episodes of drought and the concomitant problems of food and water scarcity. The likelihood of future droughts is believed to be highest in regions that are already prone to such cycles or conditions. In the Asia-Pacific region, this includes India, Bangladesh, Nepal, Bhutan, Cambodia, and Laos. Prolonged drought can severely affect agriculture and food production, energy production, and public health.[6] Due to population growth and economic expansion, demands for food, water, and energy in the Asia-Pacific are expected to increase by 35, 40, and 50 percent, respectively, before 2030.[7] Climate change, along with poor conservation measures, is expected to reduce freshwater reserves and agricultural production while also affecting regional fish stocks.

Asia-Pacific Country Vulnerabilities to Climate Change Effects

Analyses of climate change-related trends indicate that several areas of the Asia-Pacific are likely to be more significantly affected than others. The impli-

cations for human security will largely be a function of more than just geography, climate, and weather but also of the capacities of local human systems (e.g., industries, markets, and governments) and communities to respond to those effects. We have identified countries that are most vulnerable to climate effects by synthesizing the results of two widely referenced models: the Global Adaptation Index (GAIN) and the Climate Change Vulnerability Index (CCVI). Moreover, we have provided a hierarchy of their relative susceptibility to the change in climate during the next 30 years.[8]

Most Vulnerable: Bangladesh, Cambodia, Nepal, Myanmar, Philippines, and Papua New Guinea

Each of these countries faces several likely dangers, including flooding, water scarcity, and agricultural stress, and are in this category because of these effects but also because they have large, vulnerable populations with relatively little resilience. They are highly likely to experience climate-related crises affecting millions of people in countries where governance is relatively weak and inter-ethnic and nationalist tensions exist. They will require significant assistance from the international community.

Highly Vulnerable: India, Laos, Vietnam, and North Korea

These countries are expected to face several climate-related risks but not to the extent or with such low resiliency as the most vulnerable group. Still, they will likely require assistance to address their difficulties.

Vulnerable: Indonesia, Thailand, China, and Mongolia

The remaining nations are estimated to face less severe future environmental threats or to have greater national resilience to prepare them to address the effects of climate change. Though vulnerable, the core economic and political structures of these nations are not likely to be at risk from climate change-related effects.

Societal Responses

Resource Scarcity and Competition

Several case studies suggest a link between resource scarcity and environmental stress and human conflict in such places as Somalia and Syria. Some recent studies have found correlations between higher temperatures and violence across various settings and periods of time, although there is not yet a general consensus.[9]

In the Asia-Pacific, the effects of climate change, poor conservation, and ineffectual regulation of natural resources are expected to reduce freshwater resources, undermine agricultural production, and cause regional fish stocks to

dwindle and shift.[10] Many governments in the Asia-Pacific are concerned with protecting and conserving their native resources as well as finding additional resources, but in many cases, natural resource pools cross national boundaries so that unequal national efforts to conserve resources undermine success and can generate international tensions. Rising levels of resource competition and *tragedy of the commons* failings can drive overutilization and nationalist or ethnic factionalism.

In recent years, regional resource contention—for example, maritime boundary claims, fishing, and oil exploration rights—has intensified in the South China Sea. Strong nationalistic language and symbolism are used in arguments about territorial claims and the use or management of transnational resources. Although regional economic integration has improved the lives of millions across the Asia-Pacific and cooperation, not conflict, has generally prevailed among the nations in the region, these increasingly contentious issues portend a possible future region where droughts, floods, and food and water insecurity combined with fierce nationalist antipathies could lead to instability and conflict.

Mass Migration

Human immigration (across national borders) and emigration (defined here as immigration within national borders) has been a common, recurring feature of the Asia-Pacific. Populations driven by misery and insecurity in times of natural disasters, war, or political violence flee to cities and across borders. Rarely have these migrations resulted in conflict. Nevertheless, migrants are often poorly skilled and ill-equipped to succeed in their new communities, and their frustration can drive them to engage in crime and violent acts. In some cases, migration across national or ethnic borders that pits one nationality or religious group against another, as seen in Bangladesh and India between Muslims and Hindus, has led to religious persecution and violence.

The effects of climate change could trigger migratory waves in the future, raising the risk of destabilization and conflict. Some regions of the Asia-Pacific, especially along the major river systems and deltas in South and Southeast Asia, are increasingly prone to floods and cyclones—events that already drive episodes of migration.[11] When states are already engaged in tense situations, such as the border dispute over Kashmir or the Arunachal Pradesh region between China and India, additional stressors such as rapid migration could cause a rapid escalation in tensions, especially considering the demographic changes. *Youth bulges* will be common across the Asia-Pacific in the coming decades. Researchers have identified this demographic condition whereby reduced infant mortality rates coincide with high fertility rates to produce higher than usual numbers of young adults. Youth bulges could add to the volume of pop-

ulation that is frustrated and anxious to flee when climate change-related impacts are felt.

Lastly, urbanization, which is projected to increase in the coming decades, already creates serious tensions between city dwellers and rural migrants seeking work. Much of this migration currently occurs to support skilled and unskilled labor needs, but cities often cannot keep up with the pace of migration, which would be especially true considering future youth bulges. Misery, frustration, and outrage in densely concentrated, and often ethnically defined, areas of cities pose serious risks for instability.

State Policies or Actions

As such effects as water scarcity, agricultural failure, and storms intensify, populations may demand government action. Indeed, climate change-related problems are already widely recognized in the region. Some governments, China being a prominent example, are taking measures to respond; for example, building dams to manage water flow and generate energy as well as regulating industry and development. Other governments are doing relatively little. When state actions—or inaction—create unequal costs and benefits for different groups (e.g., rural vs. urban residents or lower vs. higher income populations), they can create or exacerbate political and societal divisions. State policies and actions, and their associated risks, take various forms.[12]

In cases where resource pools cross national boundaries, government actions can create international tensions. The likelihood of conflict increases when countries are already engaged in disputes. One of the primary concerns in the Asia-Pacific region relates to water. Several river basins traverse the political boundaries of multiple countries (e.g., Indus, Brahmaputra, Meghna, Ganges). State policies in upstream countries often affect countries downstream, which can create tension. This tension has been demonstrated on the Brahmaputra River, which is shared by Bangladesh, China, and India. China benefits from its upstream location and has established numerous dams and river diversions. India and Bangladesh have complained about China's unwillingness to discuss planned projects; nonetheless, they too have built or are building dams and other projects with questionable long-term effects.[13]

Over the coming decades, these decisions and actions, or lack thereof, will take place under exceptionally dynamic political conditions. Several Asia-Pacific countries are poised to democratize, which has historically been a highly unstable process. Climate change-related effects are likely to present another set of complex challenges—along with economic inequality, ethnic and regional divisions, and environmental degradation—which will complicate and raise the risks involved in those transition processes.[14]

As the effects of climate change grow more severe, public and political in-

terest in climate modification or geoengineering techniques will likely increase. Such efforts include increasing the reflective capacity of the Earth's stratosphere by adding sulfur particles and cloud seeding for rainfall, which appear to be technically feasible and relatively inexpensive options.[15] Because these efforts are cheap and easy to implement compared with climate change adaptation and mitigation strategies, individual nations, or even individual people, could deploy these methods unilaterally. This may incite tensions if nations that do not consent to atmospheric modifications are adversely affected by unilateral geoengineering.[16]

Interrelated and Simultaneous Effects

When considering possible future effects from climate change, it is important to understand that those effects are not individual in nature, nor are they limited to one locality or region. They are likely to be interrelated and to occur in several regions simultaneously or in close sequence. This likelihood raises the risk to DOD and regional partner forces, which must contemplate and plan for requirements to respond to multiple crises at once or in close succession and to crises with several dimensions (e.g., protests or intergroup violence in the context of regional droughts and food shortages). It is also likely that the DOD will have to support crisis-response operations, including potentially complex ones, in different regions of the world and potentially on U.S. territory at the same time as operating in the Asia-Pacific.

Geopolitical Implications of Changes in the Arctic

One example of regional spillover involves the Arctic. The U.S. Navy's 2014 *Arctic Roadmap* estimates that by 2025 the Northern Sea Route through Russian Arctic waters will be reliably open for maritime traffic for several weeks annually.[17] By 2045, other routes are likely to be open to traffic as well and for longer periods of time, which will make the Bering Strait a busy waterway of strategic importance and could affect the relevance of other major waterways in the region including the Malacca Strait. As a result, the security and safety requirements of U.S. and partner nation forces may greatly increase in the northern Pacific Ocean. This emergence of what amounts to a new strategic theater of operations will bear implications for force structure, especially a demand for new infrastructure in the area and additional ice-capable assets and relationships across the whole Asia-Pacific region.

Summary of Regional Vulnerability

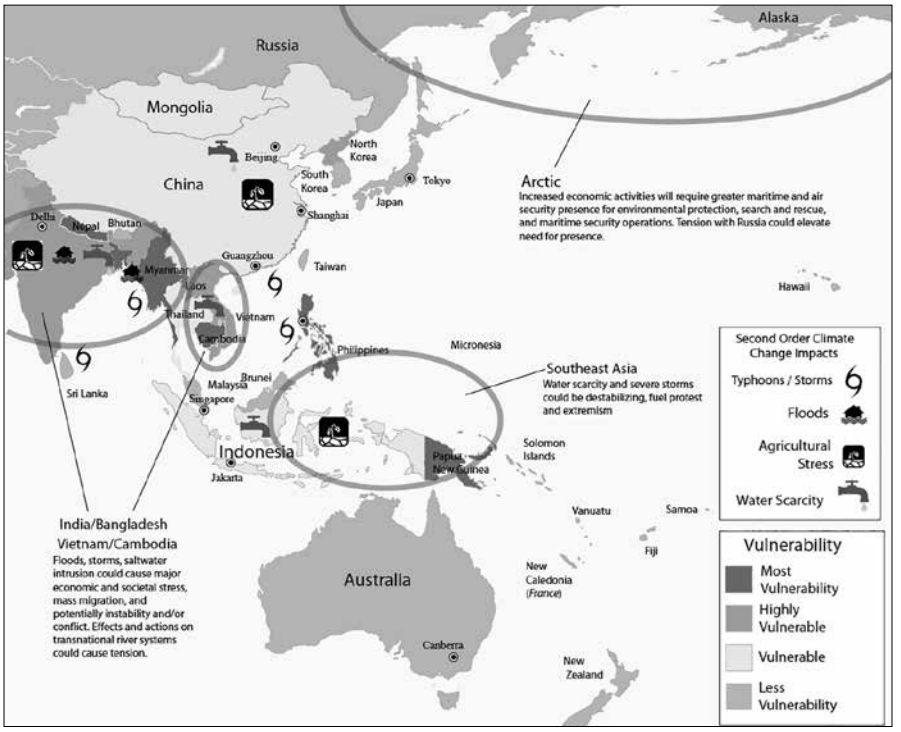
During the next 30 years, regional climate models indicate that several Asia-Pacific countries will suffer from a combination of the risks and vulnerabilities described above. Figure 1 shows the countries estimated to be the most vul-

nerable, and least resilient, to climate change-related effects. Three "hot spot" regions, where current patterns and trends suggest that environmental, demographic, and political risks converge, are also indicated. These regions are particularly prone to future instability and crisis as the effects of climate change intensify.

Current Forces and Missions

Before considering the future effects of climate-related factors on U.S. military operations and force structure in the Asia-Pacific, we must first describe how natural disasters and related crises have affected U.S. military operations there in recent years.[18] Between 1970 and 2003, more than two-thirds of the contingency-response incidents in the Pacific involved humanitarian assistance and disaster relief (HADR) conducted by the U.S. Pacific Command (USPACOM), which is the DOD joint combatant command responsible for all military operations in the theater. The next largest categories of operations were shows of force and preparations and executions of noncombatant extraction operations. Figure 2 depicts the level of effort that the U.S. military put into each response. Two metrics that reflect the level of effort are the duration

Figure 1. Regional vulnerability to the effects of climate change



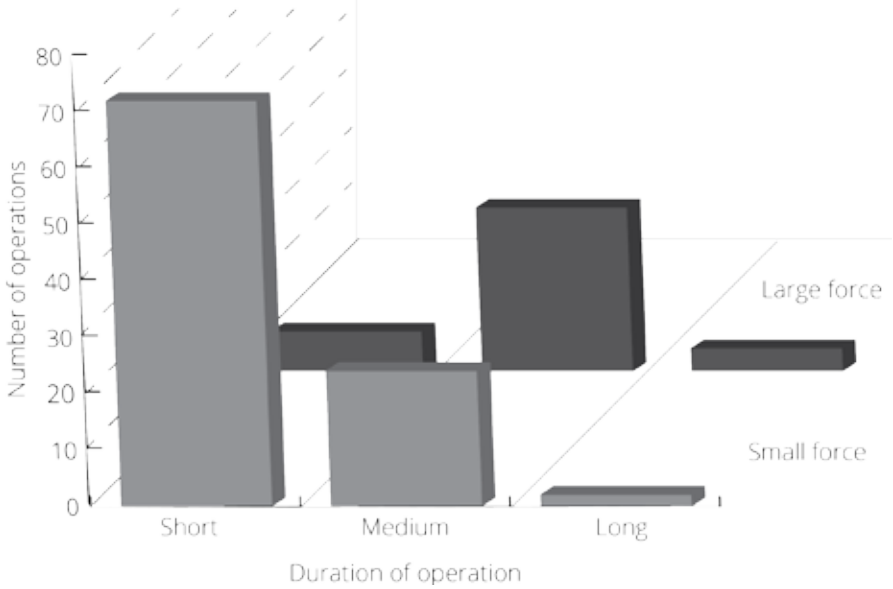
Adapted from Ralph Espach et al., Climate Change and the Future of U.S. Military Operations and Security Cooperation in the Asia Pacific*, by MCUP.*

of the response and the scale of the response (i.e., the number of assets and troops involved). For duration, we define short as one week or less, medium as one week to 90 days, and long as more than 90 days. For scale, we define small as follows: for the Air Force, fewer than 7 aircraft; for the Navy, 1–3 ships or a Seabee detachment; for the Marines, a squadron or company; for the Army, a humanitarian assistance survey team or 350 troops. We define large scale as: for the Air Force, more than 20 aircraft; for the Navy, more than 30 ships; for the Marines, a Marine expeditionary force (MEF) of 47,000 sailors and Marines or Marine expeditionary brigade (MEB) of 4,000–16,000 sailors and Marines; for the Army, a division of 10,000–15,000 soldiers; or a combination of small and medium assets.

Most of the events were short, generally lasting only a day or two. Political events caused the responses that took more than 90 days. The others were a relatively proportionate mix of political and natural events. The most common responses at all levels of scale and duration were for tropical storms and floods.

Figure 3 depicts the frequency of response of each Service, helping to identify the specific Services and implied capabilities that are most relevant to Asia-Pacific operations. Air Force assets have been in highest demand, although only for short spurts, generally to deliver supplies via airlift to affected regions. Furthermore, the Air Force has responded more than the other Services have. Only 25 percent of Air Force events were part of joint operations, whereas the

Figure 2. Response by level of effort



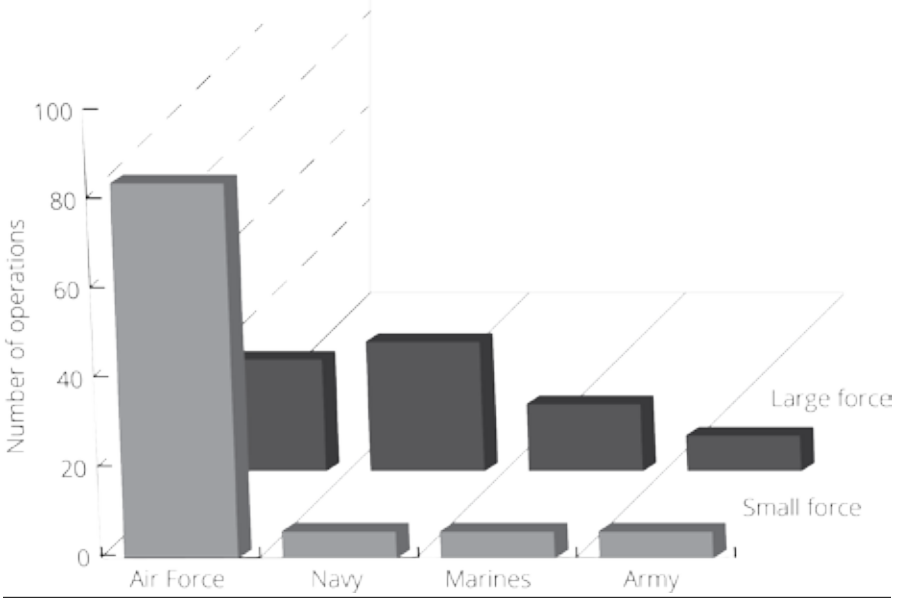
Adapted from Ralph Espach et al., Climate Change and the Future of U.S. Military Operations and Security Cooperation in the Asia Pacific*, by MCUP.*

other Services were involved in joint operations 75–90 percent of the time. Joint responses tend to correspond to higher levels of effort. The Navy and Marine Corps have usually been involved in more sustained surges, and their operations have typically involved larger levels of effort. The Army has been least in demand, participating in only about 10 percent of events, apparently because that Service has generally been less suited to the quick-response actions that disasters require.

It is important to note that the State Department actually manages U.S. national foreign disaster response efforts. Specifically, within the State Department, the U.S. Agency for International Development (USAID) Office of U.S. Foreign Disaster Assistance (OFDA) is in charge of coordinating all government and military disaster assistance efforts. Thus, in the case of HADR operations, the U.S. military supports other government agencies instead of the afflicted nations directly and participates in the relief effort only at the formal request of the host nation. Furthermore, the U.S. military does not respond to all natural disasters. In fact, in recent history, it has responded to only about 10 percent of them.[19]

Information about USPACOM's current and recent operations and capabilities for theater security cooperation (TSC) and HADR efforts provides useful background for our discussion of future challenges resulting from climate

Figure 3. Level of effort across Services



Adapted from Ralph Espach et al., Climate Change and the Future of U.S. Military Operations and Security Cooperation in the Asia Pacific*, by MCUP.*

change. There are four key points worth considering. First, climate- and weather-related issues already affect USPACOM operations on a regular basis, and USPACOM's TSC and HADR missions most directly address these issues. Second, TSC activities are linked to strategic objectives beyond helping partners and the DOD improve resilience to environmental change or crises. Nevertheless, there have been opportunities to apply TSC efforts to address environmental concerns. Third, trends in OFDA's declaration of foreign emergencies and its requests for military support indicate that global and regional stability and strategic interests strongly influence our national security leadership's willingness to involve the DOD in disaster response efforts. Disaster response is a fundamentally interagency process and the DOD is only occasionally called upon to help. Fourth, the Air Force is the U.S. Armed Service most frequently deployed for HADR; it delivers supplies and assistance on a short-term basis. Longer-term operations sometimes involve the U.S. Navy and Marines, but these have been relatively few in recent decades. The Army has been the least called-upon Service to support these operations.

Potential Changes to Forces and Missions

In 2007, the CNA Military Advisory Board released a report titled *National Security and the Threat of Climate Change*, which argued that climate change is a threat multiplier for instability in some of the most volatile regions of the world, exacerbating risks to U.S. national and regional security interests. The authors of the report argued that climate change may increase the chances of conflict and affect weapons systems, platforms, bases, and military operations.[20] After publication of the CNA report, numerous authors and organizations as well as government, intelligence, and military offices have written similar assessments demonstrating the need to consider these issues. The inclusion of climate change into the 2008 *Quadrennial Defense Review*, for example, was a direct outgrowth of the CNA report. We organize the future challenges from climate change for military operations into three categories: operations, capabilities, and posture. Operations are the activities that the DOD and armed forces conduct to accomplish their missions. Capabilities are the resources and assets required to conduct those operations. Posture refers to the force structure, geographic positioning, and international access and agreements relevant to conducting those operations.

Operations

The DOD's official missions in the Asia-Pacific are to deter aggression, advance regional security cooperation, promote peaceful regional development, and if necessary, respond to crises as well as win the nation's wars. The military's capabilities for rapid deployment, worldwide reach, heavy lift, and command and

control, however, provide significant capacity for the support of humanitarian assistance missions. The issues raised earlier in this article do not portend dramatic changes in the types of missions. The scenarios envisioned fall within the scope of crisis-response activities that the U.S. military has conducted over the years. We do not anticipate any change to these missions as a result of the effects of climate change, although the effects may pose various challenges to regional development and stability. Furthermore, there may be changes in the frequency, duration, and severity of the scenarios that could cause changes in the requirements for military forces.

Over the next decades, the DOD missions most likely to be affected by climate change in the Asia-Pacific are TSC and HADR. The military could be required, however, to conduct stability operations related, at least in part, to climate and weather effects. In addition, though only indirectly related to the Asia-Pacific region, USPACOM may be asked to provide greater presence and support further north because of rising demands for greater presence in the Arctic.

USPACOM's concept plan for foreign humanitarian assistance lists the potential types of operations the military might undertake: preventive medical assistance, security for warehouses and distribution points, improvement of road networks and infrastructure, and maintaining public order and security, including the demobilization of belligerents. The types of operations include establishing and managing aerial and sea ports of debarkation, strategic air and sealifts, aid delivery, water purification, and mortuary affairs. The military provides security as needed, but for the most part, military HADR operations focus on providing logistical support.

Capabilities

Understanding the impact of climate change and how that will change the demands on the U.S. military is important because, historically, the military has not sized or structured its forces to meet HADR requirements. Rather, force structure is based on the requirements to fight and win major combat operations. Moreover, a more general requirement is to be ready to respond to events as they arise. We do not expect significant changes to U.S. military capabilities in the future in response to demands for TSC or HADR operations. Indeed, TSC and HADR are missions USPACOM conducts regularly with capabilities and assets primarily assigned to other key missions.

Primary relief needs for HADR include fresh and clean water, food, sanitary facilities, and shelter. In most cases, the earlier the relief is provided, the better the effect. Highly desired capabilities include both strategic airlift to stage supplies in-theater and helicopters to move the supplies locally, runway repair to facilitate the arrival of supplies, and command and control systems for

communications and maintaining situational awareness. Each Service provides a set of appropriate capabilities, with significant overlap among them. Moreover, each also has particular strengths that are relevant in different ways to the HADR requirements.

The competencies and global reach of Air Force platforms is critical for meeting those requirements. Strategic lift is a fungible and quickly redeployable asset. During international disasters, the Air Force is the only military force that has the airlift and air refueling capability to provide immediate relief supplies and personnel in response to global emergencies. In addition, the Air Force is developing new rapid runway repair technologies, which could also support expeditionary operations in devastated regions.

The other Service branches also provide unique capabilities; for example, Navy and Marine Corps platforms provide support from the sea. This capability provides two advantages. First, it reduces the military footprint on a foreign nation's sovereign territory, thereby facilitating the delivery of supplies while minimizing concerns among the local population and host nation government about military aggression or dual-purpose activities. Second, it reduces the need of the U.S. military for force protection ashore because military personnel delivering relief supplies spend less time on the ground. Having a small footprint ashore was important during the tsunami relief operation Operation Unified Assistance in the Aceh Province of Indonesia where HADR took place during a civil war in 2004.[21]

Amphibious ships and helicopters are key assets. In some cases, tactical lift (i.e., local movement of supplies to those in need) provided by naval forces is more important than strategic airlift—the wholesale movement of supplies from the United States or other contributors to the affected region. For example, in Operation Sea Angel, instigated after a cyclone hit Bangladesh in 1991, by the time the U.S. military had entered the picture, the greatest need was one of providing transportation capabilities to deliver supplies. The Bangladeshi government and nongovernmental organizations (NGOs) already had enough relief supplies, but they had no way of transporting them to the affected populations, especially in remote populations. As a result, the U.S. military's transportation capabilities were an important asset to the international effort, and the military focused its operations on providing transportation.

Other pertinent naval capabilities and strengths include

- employing Seabees who can provide expeditionary engineering capabilities to prepare sites for airfields and camps and to restore services;
- assisting with the organic production and distribution of potable water, often a critical relief need; and

- preparing hydrographic surveys, which can be critical for post-event analysis.[22]

While the Navy can provide services needed early on during disaster events, the Army is better positioned for engaging situations in a different manner. Although less rapid and mobile, the sustainability of Army forces makes them well suited to longer-term, humanitarian assistance efforts and pandemics. These could include making improvements to road networks and infrastructure, providing medical training and treatment centers, and helping to maintain public order and security as the host-nation government pulls through the difficult situation. That said, the key contribution of the Army is to provide security operations, including security for warehouses and distribution points, protection of key assets (e.g., communications sites, power plants, and other utilities), and force protection. The Army is not a quick-reaction, expeditionary force of the type usually needed to support disaster relief operations, but the Army has been developing what it calls Pacific Pathways to improve flexibility.[23]

Given that long-range cargo aircraft are fungible and that supply missions are of short duration, during the next several decades the Air Force should be able to orchestrate the available fleet to meet even unprecedented levels of requirements. The same could be said about maritime platforms; USPACOM itself has numerous suitable vessels in various configurations. The availability of partner nations' assets would offer further options and flexibility. It should be noted, however, that a disproportionate share of the anticipated effects of climate change in the Asia-Pacific will affect coastal areas, which suggests a rise in demand for capabilities and assets, such as shallow-draft vessels, small-deck amphibious ships, littoral combat ships, and other vessels that support helicopter operations.

Despite our overall assessment that USPACOM's expected capabilities across the Services for the coming decades should be sufficient for its growing HADR requirements, it is worthwhile to consider the possibility that natural, and human-influenced, disasters may occur more frequently, for longer periods of time, or under more stressful conditions. In 2007, the DOD was tasked to respond to four HADR operations—an 8.0 earthquake and tsunami in Peru, Hurricane Felix in Nicaragua, flooding in the Dominican Republic, and Cyclone Sidr in Bangladesh—in a period of four months. The U.S. military was capable of providing support in response to each of these disasters. Still, increasing numbers of operations in a short period of time may become a "new normal," potentially within a less stable international context.

Given the seriousness of slow-onset disasters, such as drought, sea-level rise, and their concomitant effects, we expect rising demand in the region for

TSC activities related to those challenges. The following types of capabilities and assets will likely be useful for responding to this demand:

- medical subject-matter experts who can assist partner nations in addressing the wider spread of vector-borne diseases
- civil engineers who can provide infrastructure and logistics support especially in isolated areas
- legal subject-matter experts who can define and align regional legal standards to allow multinational groups of experts to work together
- military platforms and systems that can support strategic airlift and sealift for DOD and partner nations

We recommend that military acquisition and planning protect the above capabilities and areas of expertise so that sufficient capacity will persist if the demand rises.

Responses to slow-onset crises usually involve the military in the later stages, when states need assistance to quell violence, restore state control, and help with humanitarian operations. In a future where slow-onset crises will afflict more than one country at a time and where governments are at a loss to address fundamental causes (short of climate modification measures), however, scenarios could involve persistent involvement of military assets in support of host nations, the U.S. government (USG), and other partners.

Military capabilities relevant to long-term stability operations include policing, refugee control (i.e., enabling and securing camps with stakeholders), and border protection. This set of operations overlaps with those commonly referred to as peacekeeping operations. During the last 20 years, these operations have generally been the purview of United Nations troops, and U.S. involvement has decreased dramatically. In the future, however, regional strategic interests may increase pressures for U.S. military ground forces to become more involved in these types of security operations in the Asia-Pacific.

Overall, there is much uncertainty about long-range trends, including the rate of development of slow-onset problems in particular countries and localities. Thus, an initial recommendation is for the military to continue contributing to innovative research on indicators and early warning systems as a means to reduce uncertainty over time and guide future operations and investments.

We recommend that the USG promote regional partners to procure the following capabilities, in particular, which would be most relevant to crisis operations in the future. The United States should promote and facilitate partner acquisition of assets and systems required for airlift and sealift to provide inter-

agency support for HADR operations. Capabilities for tactical lift—amphibious ships and other platforms for helicopter operations—are also valuable. The DOD should consider working with regional allies to assemble, equip, and train mobile medical teams and facilities, which are useful not only for HADR but also more broadly. The DOD needs to consider securing naval assets and systems for maritime security and maritime domain awareness to address problems affected by or related to climate change, including illegal fishing, piracy, and maritime territorial and resource disputes. Analysts expect these actions to worsen as climate change affects resource pools and access, especially in nations where governments are unable to attend to the socioeconomic needs of their people or protect critical natural resources. The plague of piracy in the Gulf of Aden and other areas of the African coastline, for example, are partly a response to dwindling fish stocks in those waters, the result of decades of uncontrolled and often illegal fishing, often by foreign fleets.[24]

Posture

Forward presence through the U.S. military's network of bases, operating locations, regular regional deployments, and access agreements with partners is an important quality that enables quick and early responses in the theater.[25] There can be significant challenges to HADR operations if U.S. forces have no presence or routine access to the operational area. Pacific Rebalance, the current U.S. strategy to increase the focus on the Asia-Pacific region, further strengthens that quality and those capabilities.[26] In addition to having more forces positioned to respond in a timely manner for HADR operations, military situational awareness and command and control capabilities allow it to lean forward, preparing even as it awaits formal USG assessment of other options and an official request. Naval assets in particular can move into position tentatively, and all Services can have prepositioned supplies staged nearby.

The U.S. military Services are rebalancing in various ways, some of which are relevant to risks related to climate change. The Army's Pacific Pathways, for example, involves the development of small units that will be forward deployed for quick response to humanitarian emergencies or regional threats. The Army has a plan for meeting greater demands for HADR and for working more closely with foreign militaries to build their capabilities.

The demand for U.S. maritime forces is likely to remain high because of security operations in a region where so much valuable economic activity is in the maritime realm. Current tensions over maritime territorial rights are unlikely to go away and may intensify as important resources such as fish stocks dwindle and shift. Naval forces stationed in the region can provide quick response to disaster situations. Rotational deployments around the globe help meet this demand. Furthermore, new concepts for maritime prepositioned ships allow

them to be better able to efficiently off-load particular sets of equipment and supplies, and conduct operations from the sea, rather than while tied to a pier. These capabilities allow for more tailored support to crises.

Posture for missions ashore is related more to prepositioned equipment and basing agreements than it is to maintaining land-based forces in-theater. Maritime capabilities support the movement of land-based forces via strategic airlift or amphibious lift as crises evolve. An important component of the DOD's current strategy in the Asia-Pacific is to strengthen partnerships, which among other things, can lead to agreements that provide sustainable access for forces and supplies to flow to the region.

Implications for International Security Relationships

Several of the region's most industrialized countries—Japan, Australia, South Korea, Singapore, Thailand—are assessed to be most vulnerable to climate change-related risk. These countries, however, are likely to have greater resiliency, and more resources, than many other countries for dealing with the effects of climate change. Part of that resiliency is related to their longstanding traditions of institutionalized, stable democracy (with Thailand lately posing a troubling exception). In contrast, several of the countries assessed as most vulnerable to climate change effects have recent histories of intergroup violence, insurgency, civil war, and terrorism. Bangladesh, Indonesia, Myanmar, Papua New Guinea, and the Philippines seem to face unusually high risks of climate change-related effects combining with societal divisions and weak governing institutions to generate instability and conflict.[27]

Given that most of these countries have close relationships with powerful regional neighbors (e.g., China and India), the United States is unlikely to be their only or first-choice partner in response to the effects of climate change. Only the Philippines and potentially Papua New Guinea, which could also turn to Australia because of their history and proximity, would be likely to turn principally to the United States. For this reason and considering the growing military capabilities of nations in the region, we assess that the United States will likely play a supporting and potentially coordinating role in future regional security operations with a combination of allies and emerging partners. It is difficult to imagine a security crisis or disaster response in Nepal, Myanmar, or Cambodia, for example, without strong Indian or Chinese involvement.

During the next three decades, several trends are likely to shape the way U.S. allies and partners in the region view and approach security cooperation with the United States and other regional partners. First, most nations in the Asia-Pacific will simultaneously grow larger in population and wealth and become more capable of wielding international influence. Many of them are not current U.S. allies or strategic partners, which will result in a decline in the

weight of current U.S. allies and partners, such as Japan, Australia, the Republic of Korea, Singapore, Thailand, New Zealand, and the Philippines, relative to other "emerging" powers.

This general, regional rise in global importance will center, in large part, on China's continued emergence as a first-tier global power, a regional giant. Because of China's rise and the expansion of its influence, other countries in the region are likely to stay motivated to strengthen ties with the United States as a means of balancing that influence. Striking a suitable balance between China, the regional giant, and the United States will continue to be a delicate endeavor, requiring constant tinkering. U.S. allies and strategic partners during the next 30 years are likely to face more nuanced decisions about supporting the United States than they did during the Cold War, when ideological division and superpower competition presented governments with a stark choice that carried fewer economic, educational, social, and domestic engagement complications. The Soviet Union during the Cold War was never a regional hegemon wielding influence across the cultural-economic-political-military spectrum in East Asia as China may become.

Another important trend is the continued strengthening of security cooperation among some U.S. allies and strategic partners. Their security cooperation is likely to be particularly productive and advanced in noncontroversial areas such as HADR, and therefore adaptable to addressing climate change effects, rather than for traditional security challenges involving international conflict. One recent, important example of this trend is the progress in U.S.-Japan-Australia cooperation with South Korea. Furthermore, U.S. allies and strategic partners along with the United States are increasingly likely to work through regional institutional mechanisms on climate change-related cooperation in the future. During the next 30 years, regional institutions such as the Association of Southeast Asian Nations (ASEAN) Defense Ministers Meeting Plus, the ASEAN Regional Forum, the East Asia Summit, and the South Asian Association for Regional Cooperation will likely evolve to become more useful to a wider range of regional cooperation.

The Importance of Emerging Partners

In recent years, emerging nations such as Bangladesh, China, India, Indonesia, Malaysia, Singapore, Thailand, and Vietnam have experienced faster economic growth rates and are modernizing their defense capabilities and doctrines in both air and maritime domains. In several cases, they are increasing their cooperation with the United States and its strategic partners as well as with each other.[28]

Of these nations, only China, India, and Russia are potential panregional

players, while Indonesia, Malaysia, Vietnam, and Bangladesh are likely to be economically and politically influential in their Southeast and South Asia subregions. These emerging partner countries could be especially useful to security cooperation in niche areas or particular cases; for example, Vietnam could be an important partner for the United States in dealing with the effects of climate change in high-risk Cambodia, particularly if the U.S.-China relationship were to complicate or prohibit possibilities of direct U.S. involvement. Future U.S. political and defense leaders should remain cognizant of the critical importance of such partnerships in the region.

For the most part, these emerging partner countries are still on the steepest curve of nation and state building. While each has made tremendous strides in national strength, they also tend to face massive domestic challenges, such as "middle-income traps," rapid aging, significant environmental erosion, and in some cases, internal separatist movements (e.g., the West Papua movement in Indonesia and the ethnoreligious insurgencies in southern Thailand and southern Philippines). Also, there are significant tensions both between countries in the group (e.g., India-China, Russia-China, India-Bangladesh, Indonesia-Malaysia, and China-Vietnam) and with countries outside the group (e.g., Indonesia-Australia and Russia-Japan). These considerations are reasons for caution in terms of whether they can replace key American allies and strategic partners for security cooperation.

Prospects for Cooperation in HADR

For all countries in the emerging partner grouping, HADR response is a relatively uncontroversial way to develop bilateral ties with regional countries and participate in regional institutions. It is also an area where they can work with the United States without drawing the ire of certain domestic constituencies. In countries such as Indonesia and Malaysia, for example, where domestic currents are critical of the United States for a variety reasons, there is appreciation for America's ability and willingness to assist in the case of natural disasters and other humanitarian needs.[29]

China, India, and perhaps Russia also seek to be seen as responsible powers in the Asia-Pacific and have the capacity to provide HADR in cooperation with and sometimes in lieu of the United States and its allies and strategic partners. Hence, their ability to provide salutary responses to the effects of climate change are likely to be a matter of national pride as well as policy interests. For Indonesia and Malaysia, founding members of ASEAN, the ability of that institution to offer public goods such as HADR is one way of demonstrating the "centrality" of ASEAN to regional affairs and, by extension, enhancing their own influence.

Considering China

Given its rising economic status and military capabilities, China is poised to play an important role in international efforts to address the consequences of climate change in the Asia-Pacific. At present, China's approach to climate change mitigation emphasizes international cooperation, notably with the United States. For instance, enhancing cooperation is a theme of a 2014 report of China's National Reform and Development Commission, which details recent U.S.-China achievements in this area.[30]

At a military operational level, China and the United States have expanded cooperation in areas that could be relevant to addressing the effects of climate change. Xi Jinping, the current Chinese president, called for a "new type of military-to-military relationship" with the United States as a core component of the broader bilateral relationship.[31] Specific initiatives include China's first-ever participation in the U.S.-led Rim of the Pacific exercise in 2014, which included Chinese naval involvement in HADR, military medicine training components, and a series of U.S.-China Disaster Management Exchanges.[32]

There are several reasons why future Chinese policy could continue to emphasize cooperation with the United States and other regional stakeholders. First, climate change represents an area in which China and the United States can achieve mutual gains, unlike more contentious issues, such as territorial disputes, cyberespionage, or human rights. Second, cooperation allows China to continue to project an image of itself as a "responsible" state, which is useful in countering regional narratives of China as an aggressive rising power. Third, as previously discussed, China faces the prospects of internal economic and social challenges related to climate change. Partnering with more technologically advanced countries, such as the United States, could better enable China to mitigate some of those challenges.

Nevertheless, it is also possible that China will adopt a less cooperative approach to climate change. At a broad strategic level, more intense competitive dynamics in the overall China-U.S. relationship could undermine cooperation even in areas of relative agreement, such as policies to address climate change. A lack of mutual trust between Beijing and Washington could also complicate cooperation.[33] In addition, China may decide to unilaterally pursue novel ways to reduce the risks of climate change, such as solar radiation management, which have not been endorsed by the United States or the broader international community.[34]

Black swan events in China or at a regional level could also lead to less cooperative, more dangerous outcomes. Such unforeseen circumstances could include a transition from Chinese Communist Party rule to a new democratic or authoritarian regime that is less capable of, or interested in, addressing the effects of climate change; an economic setback that could refocus the gov-

ernment's attention on short-term challenges rather than on the longer-term problems associated with climate change; or an armed conflict between China and one of its neighbors, such as Japan or the Philippines, which may involve the United States and could derail ongoing environmental or nontraditional security initiatives. Still, assuming the absence of such a disruptive event, we assess that China has numerous reasons and sufficient capacity to increasingly develop and offer its capabilities for responding to HADR within the region.

Policy Recommendations

The U.S. military coordinates with the State Department, USAID, and other USG agencies in efforts to work with partner nations to improve resilience of countries vulnerable to adverse impacts from climate change. Once crises have occurred, the military can help deal with complex humanitarian emergencies that involve HADR combined with state instability or conflict situations.

In our assessment, climate change-related effects are not likely to impact warfighting capabilities, operations, or plans for major combat operations during the next 30 years. Moreover, they are likely to significantly increase the demand for, and frequency of, theater security cooperation and humanitarian assistance and disaster reslief missions. Rapid-onset events, such as storms and floods, are likely to occur more frequently, be more intense, and happen in more places than in past decades. Of higher concern, because their effects are more pernicious, widespread, and harder to manage, are slow-onset problems such as water scarcity, agricultural stress, and dwindling fish stocks. These effects of environmental change on human systems and the follow-on responses they create (i.e., effects from human responses) could contribute to instability and raise risks of regional conflict, especially in crisis-prone areas, such as along the Bangladesh-Indian border and across major transnational river systems.

Theater Security Cooperation

Preparing for and addressing these effects calls for sustained DOD measures to help prevent crises through scientific and technical cooperation, mitigate damage by improving regional preparedness and resilience, and strengthen regional capabilities for disaster response. We recommend that the DOD expand its TSC activities, which are essential for improving regional resilience and cooperation, improving goodwill and access for U.S. forces, and promoting stability and security across the region.

We recommend that the DOD leadership crafts its TSC efforts in ways that leverage the vitality of multilateral regional institutions including the ASEAN Defense Ministers' Meeting-Plus and the ASEAN Regional Forum, and that the DOD encourage greater investment and cooperation from key emerging powers, such as India, Indonesia, Thailand, and Vietnam. Within 30 years, these

and other Asia-Pacific nations are likely to have significant regional influence and operational capabilities. Their influence is likely to be strong in subregions that are expected to be severely affected by the effects of climate change, such as the India-Bangladesh-Myanmar coastal areas and the stretch of islands from Papua New Guinea to the Philippines. To promote regional resilience, we recommend that the DOD continues to encourage multilateral dialogue, joint exercises, and cooperation on HADR operations through bilateral, trilateral, and multilateral agreements and organizations. We recommend that the DOD and wider USG security cooperation efforts include dialogue with, coordination with, and inclusion of China. Climate change-related security problems, especially the need for capacity building and adaptation to meet these security problems, offer useful framework for collaboration not only with China but also with NGOs and private sector actors.

Humanitarian Assistance and Disaster Relief

Humanitarian assistance and disaster relief operations are already an important component of USPACOM's workload. In the future, we expect it to become a greater portion of actual operations, and it may well take on a more strategic significance in support of either regional stability and security institutions or new alliances and coalitions. Even with more intense and frequent storms, floods, droughts, and other weather events, USPACOM's resources and capabilities for supporting HADR missions are likely to be sufficient. We anticipate that the DOD, however, will likely be required to support and, at times, lead responses that are particularly complex and dangerous to key partners. A regional future that includes dwindling resources, water, and food within a context of high inequality as well as ideological and international tensions presents scenarios where one or more complex HADR operations (i.e., an HADR operation during an armed conflict or insurgency operations) are required. Such operations could last for months or longer. If so, concurrent HADR operations would likely be required. Adding further difficulty, these complex and potentially multiple operations would have to be conducted without compromising USPACOM's capabilities to support its other high priority missions.

Better Planning and Monitoring

In the coming decades, DOD planners should be conservative in their risk estimates and consider crises to be likely. In our view, DOD planners and their government partners should prepare for the possibility of more than one crisis, and resulting conflict, occurring at the same time within the Asia-Pacific. The DOD should continue to promote the development of analytical methods to monitor country and regional risk levels of short-term (0–3 years) and mid-term (3–5 years) environmental and climate change-related effects.

The risks associated with future climate change-related effects in the Asia-Pacific in the next 30 years do not appear to call for significant changes in force structure or assets. USPACOM has enough resources and assets for these operations as well as impressive logistical and operational flexibility. Furthermore, various regional USPACOM partners, including more than just the national security forces but also corporations, multinational organizations, and NGOs, are improving their own HADR preparedness and capabilities. Steady improvement of regional security cooperation will improve HADR outcomes.

Promising regional trends notwithstanding, the USG has not called on the DOD to be as responsive to foreign disasters as it could, for example, at the rate seen during the Cold War. Also, there is significant uncertainty about the future speed and intensity of the effects of climate change.[35] Since political and social factors in the region are variable, and scientific knowledge of the effects of climate change is improving every year, we recommend continued, careful monitoring of projected climate change-related effects as well as trends in human collective responses to those effects and an openness to future reevaluation as expectations and risk levels change.

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Examining Long-Term Climate-Related Security Risks through the Use of Gaming and Scenario Planning

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Abstract: This paper examines four possible climate change-related security risks that emerged from an international game and scenario-planning session held in Delhi, India. Specifically, we discuss how climate change may increase nationalism and policies of internalization in developed countries; the impact of large-scale, climate-induced migration on a country's international policies, economic situation, and defining cultural attributes; the competition for limited resources as a source of friction and the impact on policies and international relations; and the potential for an emerging disparity between regions over the consensus and control of climate change-related technologies.

Keywords: gaming, scenario planning, climate change, security risks, nationalism, internalization, migration, resources, politics, economy, technology, culture, international relations, European Union, geoengineering

The consequences of climate change are uncertain, but they have the potential to adversely affect human interests. For years, leading scientists have claimed that climate change is a problem of risk management.

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To manage these risks, we must assess them not only from an environmental standpoint but also from social, political, and security standpoints. Over the past year and a half, the United Kingdom's Foreign & Commonwealth Office (FCO) held multiple meetings and compiled a 2015 report, *Climate Change: A Risk Assessment*, to better understand the risks associated with climate change. In the assessment, the FCO touches on the environmental, social, political, and security risks associated with climate change.[1] In support of the assessment research, FCO, partnered with the Skoll Global Threats Fund (SGTF), asked CNA to provide analytical support for an assessment of risks precipitated by climate change. To do this, we designed and executed a game and scenario-planning session that explored the effects of climate change on global security and economic prosperity. Our conclusions speak both to the interplay between climate change, security, the economy, and international and domestic politics as well as the use of interactive tools and methods to maximize innovative and imaginative thinking.

In this article specifically, we briefly discuss the benefits of using gaming and scenario planning for our approach, and we describe how we refined the climate risk event during a test run.[2] After summarizing each of the four games, we conclude this report with a discussion of our four major findings in the order of most to least prominent:

1. Climate change may trigger increased nationalism and policies of internalization in developed countries.
2. Large-scale, climate-induced migration and displacement may impact a country's international policies, economic situation, and defining cultural attributes.
3. Competition for limited resources may increase as a source of friction and shape policies and international relations.
4. The consensus and control of climate-related technologies may result in an emerging disparity between regions, as not all countries view these technologies in the same way, and there is little framework for their use or management.

Moreover, we made two interesting observations of participant behavior during the event. One of the more interesting observations from the game was a tipping point that emerged midcentury, when climate change began to make country players selfish, more insular, and more willing to take risks to preserve the status quo for their nations. From the scenario-planning session, participants discussed two potential shifts in governance: the potential disaggregation of the European Union and the possible emerging role of private corporations in climate-related decision making.

Event Objectives

Before designing the event, we laid out several objectives. Analytically, we wanted to understand the security implications and risks of climate change and rising temperature during the next 100 years. We did not want to focus on a specific region; rather, we wanted to explore how people and governments might react to extreme climate change and during a long period of time with significantly rising temperatures.

It was important to maximize imaginative thinking and to gain a variety of insights from the high-ranking officials who participated in the event. To reach these objectives, we used two techniques: gaming and scenario planning. On the first day, we ran the same game simultaneously with four separate player groups. For simplicity throughout this paper, we refer to each of these as Game 1, Game 2, Game 3, and Game 4 even though the rules, game boards, player roles, and other components were the same. On the second day, we held four separate scenario-planning discussion groups. By running the same game more than once, we were able to observe how different decisions by players could lead to different outcomes, reactions, and interactions. Because the players in each set could use their collective imagination, we were not restricted to the imagination of a single group. The same participants were reorganized into scenario-planning discussion groups where they raised issues that they had considered the biggest risks. Group members then debated these topics. In this environment, individuals from different backgrounds interacted and built on the issues identified by others in the group, which resulted in a rich dialogue during the two-day event.

By incorporating gaming and scenario planning into the event, we were able to offer a more flexible format for engagement and interaction between participants compared to other climate change meetings. This event allowed us to use unique tools that engaged high-level participants with a multitude of backgrounds and areas of expertise. The game placed participants in a decision-making role that encouraged them to use their imagination, while the scenario-planning session created an environment that allowed participants to expand upon topics, decisions, and outcomes that emerged from the game. The scenario-planning session also allowed cross-cultural and multidisciplinary discussions that might not have occurred in other climate or security conversations.

The Council on Energy, Environment and Water (CEEW) hosted the event on 19–20 March 2015 in Delhi, India. Twenty-four participants attended and included renowned scientists, security experts, diplomats, and retired military personnel representing perspectives from Asia, Europe, the United Kingdom, and the United States.[3]

Using Gaming and Scenario Planning for Decision Making

Understanding what the next century may look like is especially challenging because of the volatility of human behavior and decision making: both of these elements can be unpredictable. Games and scenario-planning tools, however, are designed to help better understand human behavior and decision making. These tools can help to (1) reveal the processes behind decision making, (2) understand what types of decisions could be made, and (3) understand the impact of those decisions and how different decisions could lead to different impacts. By using both tools, we can generate what the future could look like, or even what different futures could arise, even if we cannot precisely predict the future. In this event, we combined games with scenario planning to increase the depth of participants' experiences. In the scenario-planning exercise, individuals drew on what they learned in the games to influence and extend their consideration of other scenarios and other futures.

By having players participate in a complex game where they interact with each other and possible future outcomes, they begin to understand some of the key drivers, relationships, and decisions that might be encountered in the future. If senior, high-level individuals with government experience are playing the game, they bring an increased realism to those decisions and relationships. Games place the participants in the future, where they learn how they would adapt and act to new situations. Scenario planning can further extend gaming's reach by allowing participants to examine multiple possible futures simultaneously.

Neither gaming nor scenario planning can predict the future, but gaming can immerse players in a mutually constructed future that is based on analysis and research. The evolution of players' reactions and actions during the course of the game is, in fact, a simulacrum of how leaders might react in a given future. Scenario planning allows players to incorporate these feelings and reactions into considerations of a variety of expanded scenarios. Players accept or reject those scenario elements based on their experiences in the game.

How Does This Affect the Way We Think about Climate Risks?

The combination of games and scenario planning allowed for an expansive experience for the players. Players had to think deeply about how they would react to the effects of climate change in terms of one possible future, and then apply that thinking to many possible different futures, including the long future. Understanding the long future is valuable for both understanding larger climatological, economic, and social processes, as well as how leaders might react and adapt to each other over longer periods of time. Games give players a chance to experience all of these variations, which can change the way they

think about the future. One thing that games are capable of doing is identifying those ideas and actions that players may not have considered as possibilities before the game. In our games, players identified several unintended consequences and possible social behaviors that were unexpected prior to the start of the game. Players then had the chance to discuss and reinforce those consequences during the scenario-planning phase.

Can Games Predict the Future?

This is an interesting and controversial question. At some level, computer simulations often claim that they can predict a future from a set of inputs. Physical systems—for example, a molecular dynamics model—can be used to run time forward or backward for a set of physical conditions and parameters. But, computer models fail in large-scale, long-time predictions because they often fail to incorporate the element of human free will in their calculations. People can be perverse, and as modern economics shows, not necessarily behave like rational actors when making decisions.

Games allow us to incorporate these irrational, human elements into an assessment of the future, allowing us to understand what patterns may develop and how our decisions might be affected by and affect these future patterns. Future decision makers can reference these game experiences when they see familiar patterns occurring and either steer clear of potentially bad outcomes or move toward good ones based on what they learned in the games. This matters for climate risk because, while we can run models and simulations to understand future climate events given various emissions scenarios, understanding how people may react to the consequences of various actions, or inaction, is much more challenging.

Our games showed several important reactions that are likely to carry into the future; for example, we saw the following player behaviors emerge. First, there was a tendency not to engage in large-scale, global conflict between peer competitors.[4] Instead, small-scale skirmishes and fights over less developed regions occurred in the game. Second, technologists advocated the use of geoengineering as climate effects became more pronounced.[5] And third, we witnessed global fatigue with failed states and migrants emerging in the game.[6] The players saw this as driving increased xenophobia and closure of borders. We could argue that we are already seeing harbingers of the events that emerged during our games. These elements will not necessarily emerge in simulations or computer models, but clearly depend on the feelings and actions of real people making decisions. That is what games can tell us about the future: not what it will be like, but how individuals might react to it.

Game Design

The first day of the two-day event was dedicated to the game, and was designed as a strategic role-playing game that looked at the interactions between the climate, the economy, and conflict from 2015 to 2115. In strategic games, player decisions strongly influence the direction and outcome of each game. In this game, actions taken by players determined the emissions pathway for the game. In role-playing games, each player is assigned a role that determines the kinds of decisions that the players can make in the game.[7]

One of the key design requirements was that players could alter their emissions pathway to affect global environmental conditions. We wanted to avoid a predefined trajectory that was isolated from the players' decisions; therefore, the game design factored the players' behavior and investment decisions into each turn's climatological conditions.[8]

To provide sufficient flexibility for the players, we allowed them to take actions that were not in the formal rules of the game. In those cases, players worked with the game controller to determine how the action fit into game play.[9] Each of the four games was composed of six players who represented China, the European Union, India, Russia, the United States, and the region of Southwest Asia. These areas were selected because of their projected demographics, wealth, military strength, and climate impacts. Players were grouped based on their background and subject matter expertise.

To cover 100 years in one day of game play, each turn represented 10 years, meaning that events resulting from player actions, climate change, temperature increases, and sea-level rise had to be significant enough to register on the world or national decadal economic, military, or population scales. Costs had to be in the hundreds of billions and lives lost in the hundreds of thousands to millions to cause a significant change. Some events, while devastating, do not meet these thresholds; for example, the effects of a super typhoon, such as Typhoon Haiyan (2013), would barely affect the decade's gross domestic product (GDP) or population.[10] The 2004 Indonesian tsunami and the 1986 Chernobyl disaster are examples of events that would register at this scale.[11]

When a player made a decision, the outcome of that decision was based on several underlying models and mechanics for the economy, climate, and conflict.[12] The abstracted models were based on projected GDP values, regional population predictions, global climatological relationships, and other factors. For projected GDP values, we used and extrapolated data from the Central Intelligence Agency's *World Factbook* and the World Bank. Regional population predictions were based on the United Nations' population projections.[13] Global climate relationships and other factors were mainly based on the Intergovernmental Panel on Climate Change's (IPCC's) fourth and fifth assessment reports and related research documents.[14]

In the game, we held technological developments constant between players, player groups, and across time, except in a few cases. We permitted players to make advancements in military equipment and climate technologies, but we did not allow for other advancements, such as flying cars or artificial intelligence. Because we were mainly concerned with the interactions between security, climate, player behavior, and decision making, we assumed large technological advancements in other areas were incorporated into economic growth and would be a major distractor and disrupt game play.

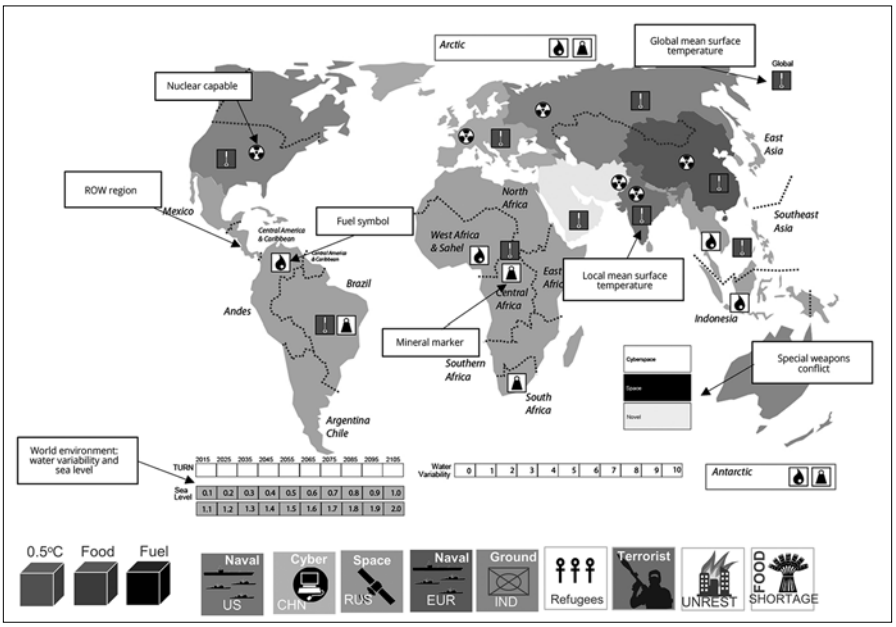
The players were asked to (1) ensure that their countries had enough food and energy to sustain their needs, (2) support their militaries, (3) protect their homelands, (4) decide whether they wanted to invest in climate mitigation and adaptation efforts, and (5) decide which investments were most important to their countries. Possible investments included, but were not limited to, increasing food production, incorporating water stress adaptations, improving civil infrastructure, researching and implementing geoengineering, building military capabilities, and exploiting the Arctic for natural resources. Consequently, player decisions changed the global temperature, sea level, and water variability.[15] In turn, players reacted to the events that were triggered by these changes. Because we ran four simultaneous games, we were able to see how players' decisions resulted in different futures.

In each game, the current state of the world was displayed on a game board (figure 1). The board contained information about global and regional temperatures, represented by red cubes, and regions' food and energy supplies, represented by purple and black cubes, respectively. Counters represented regions' military assets; the locations of migrants, civil unrest, terrorist forces, and insurgents; as well as shortages. In reference to unrest, when countries and regions were unable to meet their food, energy, water, or financial needs there was unrest, which could generate an increase in migrants, terrorists, or insurgents. Migrants could move from region to region and create additional unrest, terrorists could also move and conduct attacks, and insurgents could try to take over areas. Players had to make trade-offs between future investments and dealing with these issues.

Scenario Planning

The second day of the event featured the scenario-planning session. The same individuals who played in the game participated in the scenario-planning session. The participants were, however, placed into new groups to further diversify the discussions. During the main event in Delhi, the scenario-planning session was composed of two scenarios: one for the period between 2015 and 2045 and the other for the period between 2045 and 2075. Each scenario included the following:

Figure 1. Game board and counters



Adapted from Catherine M. Schkoda, Shawna G. Cuan, and E. D. McGrady, Proceedings and Observations from a Climate Risk Event, *by MCUP.*

- global temperature ranges, extreme world-wide climate events, sea-level rise, and global food availability
- the regional effects of these factors on China, Europe, India, Russia, and the United States
- a summary of the major climatological conditions in other key parts of the world

The primary goal of the session was for participants to explore low-probability, high-impact risks; therefore, we presented them with global temperatures at the upper end of current predictions and extreme climatological conditions.[16] Based on these environments, we asked participants to consider the types of events that might be unlikely but would have a severe impact on human security. This forced participants to consider the biggest risks, not just the most likely ones, and thus to think outside their normal comfort levels.

For these sessions, the participants—a mix of scientists, diplomats, security experts, and retired military personnel—were organized into four discussion groups of six. Each group had a moderator. By creating an environment for multidisciplinary discussion between different types of experts, the participants learned about climate change risks outside their areas of expertise. At the end of the session, each group compiled a list of the risks that they felt were the

most significant to human security. The moderators presented each group's findings to the rest of the participants. Afterward, the floor was opened up to everyone to submit their final thoughts on both the event and any outlying issues.

Washington, DC, Test Run

As mentioned earlier, we tested the game and scenario-planning sessions before the main event to refine the game materials, player roles, and climate scenarios.[17] Because of the test run, we were able to refine the game for faster and more fluid game play, thus increasing the turns played. Originally, the game materials included pages of investment options and required players to execute many numerical calculations during every turn. These detailed materials and calculations overwhelmed the players and slowed game play. To raise the game to a strategic-level, decision-making game and limit managing minute details, we incorporated these calculations into the game model and mechanics and provided players with fewer investment options.[18]

The test run game was comprised of seven players: China, the European Union, India, Russia, the United States, a "rest of world" player, and a "stateless" player. The rest of world player managed 15 different regions, most of which required minimal attention. The Southwest Asia region, however, required more management than the other regions; therefore, we eliminated the rest of world player and created a Southwest Asia player for the main event in India. Collectively, all of the players supervised the stability of the remaining regions during the main event.

In the test run, the stateless player held two roles simultaneously: global business player and terrorist player. As the global business player, this individual represented global capital and services. He or she could purchase food and fuel from the other players, warehouse it for later use, and provide food, fuel, and financial loans to players in need. This mechanic, however, further complicated the numeric calculations being made by the players without adding a great deal of insight. As a result, we decided to eliminate the global business player role. The terrorist player represented anarchy and disruption around the world. As unrest developed in countries, this individual could move terrorist forces and conduct attacks. We determined, however, that the level of global unrest around the world did not require a dedicated player, so the game controller assumed the terrorist player responsibilities.

Lastly, we adjusted the climate scenarios for the scenario-planning session. In the test run, we presented players with three different climatological scenarios. The first two scenarios were similar to the ones described above, but the third scenario included temperature increases of 6–7 degrees Celsius from today's temperatures to the period from 2075 to 2105. We found the third sce-

nario exceeded the participants' imaginative abilities. In addition, there is little scientific data on the state of the world at these temperatures to provide useful conclusions. Overall, the test run proved useful in developing and refining our game and scenario-planning sessions. It helped us to eliminate the unnecessary portions of the event, better concentrate on the interactions between key players, and as a result, better understand the impact of climate on human security.

Game Play

In this section, we briefly summarize each of the four games that were held in India. Specifically, we identify some of the main themes that emerged and how the players interacted with each other. Players for each game were divided based on their backgrounds and expertise. Individuals in Game 1 had strong scientific backgrounds, while Games 2 and 4 were composed of individuals with various military backgrounds. Players with diplomatic experience were assigned to Game 3. Recall that, by design, player decisions drove the progression and direction of the game. As each group of players made decisions, every game went in its own direction and highlighted distinct insights despite the fact that each set of players had the same set of options to choose from when making their decisions. Full analysis on these insights is provided in the later sections.

Game 1: Mutually Beneficial Mitigation

Game 1 play was characterized by the desire to eliminate unrest among the players, with the goal of reducing carbon emissions by heavily investing in energy alternatives, and by deciding to implement geoengineering techniques. At the start of the game, there was a mutual understanding among the players that any food shortages, clean water shortages, and unrest must be mitigated immediately. This agreement applied to each player's domestic situation as well as the rest of the world. In this vein, players representing China, the European Union, Southwest Asia, and the United States devoted resources to regions in need, including the Andes, Indonesia, Mexico, and parts of Africa.[19] The players felt especially responsible for regions in their spheres of influence that posed a threat to domestic stability; for example, the player for the United States frequently stopped unrest and provided food to the Andes region because of its geographic proximity and availability of natural resources to satiate the United States' energy needs.

The players representing China, the European Union, and the United States led the climate negotiations in Game 1. Each player agreed to invest in energy alternatives with a target of reducing emissions by 30 percent in each of their respective countries through alternative energy by the midpoint of the game. Those countries easily achieved this goal. The Southwest Asia and India players attempted to meet this target, but unexpected events overtook their ef-

forts. Because the India and Southwest Asia players demonstrated a good faith effort, the China and the United States players provided funding to help them meet their respective targets. The Russia player purposefully spurned all climate mitigation and adaptation efforts and instead built up the country's military. During the midpoint of the game, the Russia player allowed domestic food shortages and unrest to emerge because the player wanted to spend additional money on offensive military assets in an attempt to instigate conflict with the China player over border disputes. Since this conflict did not escalate to war, the Russia player was left with a large number of internal issues to resolve. Despite the Russia player's attempted aggression toward the China player and lack of compliance with the international emissions reduction agreement, the United States player and others assisted the Russia player with their food shortages and unrest. Throughout the game, the players consistently approached unrest with a compassionate attitude and willingness to help others.

During Game 1, players honed in on the consequences of using new technologies. Implementing geoengineering, specifically stratospheric aerosols, significantly changed the global emissions path, thus changing the frequency and severity of climatological events. This reduction in climatological events allowed players to concentrate on other issues. Early in the game, the United States player proposed geoengineering to further reduce emissions with the support of the China, European Union, and India players. In contrast, the Russia and Southwest Asia players strongly opposed these efforts. Specifically, they protested the unknown risks and the potentially negative consequences.[20] While these objections were considered by the other players, the United States player went forward with implementation, as the Russia and Southwest Asia players lacked the necessary resources and relative power to stop the United States player. This disagreement spurred a discussion about the implementation of new and unknown technologies (i.e., who has the right and ability to implement them as well as who can deny implementation).

Game 2: Eventual Forced Cooperation

Relative to the Game 1 players, the Game 2 players were generally not coordinated or cooperative in eliminating unrest and mitigating climate change. The players largely focused on their domestic natural resources, military, and economic growth. The China, India, Russia, and Southwest Asia players saw themselves as developing countries that needed to organize their domestic affairs before they could make foreign aid investments; for example, the India player felt they had to achieve near-peer military parity with the China and Southwest Asia players before they would invest internationally. Similarly, the China and Russia players built up their militaries and domestic resources. The China player acquired an amphibious task force and invested in food production for China's

growing population. The Russia player reinforced their domestic infrastructure. Lastly, the Southwest Asia player developed a robust desalination capability to generate water and greater food production capabilities to offset future food insecurity.

There were some exceptions to this behavior. The European Union, India, and United States players mitigated unrest outside their borders; for example, the European Union player deployed their military to North Africa to alleviate unrest and contributed foreign aid to other countries to develop their renewable technologies, primarily in nuclear energy. The United States and India players also invested internationally, but it was limited to their spheres of influence and still supported domestic goals; for example, the United States player quelled instability in Mexico, partly to prevent the unrest from spilling over the border. This effort was prioritized over instability in North Africa. The India player limited India's international efforts to fighting terrorism and unrest in Bangladesh and Pakistan. Given this lack of international cooperation, global instability and climate effects eventually overwhelmed individual players and forced all the players to cooperate.

This cooperation only occurred when climate change events reached a tipping point that had simultaneous impacts on multiple regions. Early in the game, only a few players decided to invest in climate mitigation and adaptation efforts. The India player invested in nuclear energy, but without consistent climate mitigation efforts from all the players, these reductions were insufficient to offset global emissions. Consequently, global temperature continued to rise in the game, forcing later cooperation. To combat the rising global temperature, the European Union player proposed geoengineering to prevent worsening conditions and offered to sponsor the effort. This proposal and the level of global instability were sufficient for the other players to agree to geoengineering. Moreover, injecting aerosols into the stratosphere required continuous investment and monitoring to avoid backsliding into dangerous global temperatures. To avoid this outcome, all the players began to contribute financial resources. Unlike the players in Game 1, Game 2 players only pursued global climate change mitigation when they faced an existential threat.

Game 3: Aggressive Self-Interest

Takeaways in Game 3 were comparable to those in Game 2, but differed drastically from Game 1. Similar to Game 2, the players in Game 3 prioritized their national security efforts, GDP growth, and resource security above global cooperation. The global cooperation that did occur centered on global shortages and climate change. At the start of the game, the United States player suggested that each player contribute a portion of their financial resources (based on economic wealth) to combat global food, fuel, and financial shortages. There were

disagreements, however, about financial contributions and domestic issues. The China player wanted larger contributions from the United States player, which was echoed by multiple players throughout the game. In addition, the other players rebuffed the Southwest Asia player's request for help when their country suffered from food shortages. The other players viewed the shortages as a domestic issue that did not warrant global assistance even though the Southwest Asia player participated in the United States player's proposal to combat global shortages.

Despite these efforts, unrest and shortages spread throughout the world. Some players placed trade restrictions on food and fuel exports in order to fulfill domestic consumption, forcing the European Union and the United States players to either pay off the shortage or allow unrest to emerge. Eventually, the China player retracted their commitment to prevent global shortages because they did not believe the investments were benefiting their country's economy. Since the Southwest Asia player did not receive assistance with food shortages, the player declared that they intended to invade North Africa for natural resources. This threat caused the other players to verbally agree to mitigate future unrest and food scarcity issues, but ultimately, most players ignored unrest until it posed a proximate threat to their country's borders.

The players also disagreed about global climate mitigation efforts. The United States player proposed that each player set emissions reduction targets based on their GDPs, a proposal which was rejected by the other players, especially the India, Russia, and China players. Instead, each player determined his or her own emission targets. Although the European Union and United States players invested in emission reductions, their reductions were not enough to slow the rise of the global temperature.

Throughout the game, the Russia player was internally focused on the military instead of on the larger global concerns broached by other participants. Similarly, the China player invested in domestically beneficial areas, such as GDP and military growth. These investments eventually triggered an arms race that caused other players, such as the United States, to reallocate funds toward their military programs and homeland security rather than climate mitigation and adaptation efforts. The players invested in additional task forces and cyber-capabilities and deployed forces in anticipation of potential conflicts with rival countries. While the European Union player periodically tried to steer the other players toward global stability, the effort was ultimately unsuccessful because of the arms race. Food shortages, migrants, terrorists, and insurgencies began to quickly grow and spread. This consistently uncooperative attitude defined Game 3, setting it apart from Games 1 and 2. Aggressive self-interest, in the end, lead to greater, more intractable problems.

Game 4: Domino Effect of Military Actions

Game 4 largely mirrored Game 3; many players focused on domestic issues and ignored global unrest and climate mitigation efforts. Similar to all the other games, the Russia player focused on domestic improvements and generally spurned international cooperation efforts, including climate change mitigation, except when the effort reaped positive benefits for Russia. For example, the Russia player convinced the European Union player to finance Russia's Arctic exploration efforts in exchange for a future fuel-trade agreement.

In Game 4, as the players representing larger countries focused on aggressive geopolitical maneuvering with little concern for stewardship and leadership, players from the smaller countries could not make an impact on climate change. Similar to the Russia player, the China player also focused on domestic infrastructure improvements, particularly food production. Anticipating future food shortages, they hoarded food early in the game and continued focusing on nationalism by building and maintaining military and defense capabilities. In later years, the China player devoted some resources to stem unrest in areas of interest and spheres of influence. For example, the China player deployed military forces to the South China Sea, one of the areas considered within their spheres of influence, to challenge the United States player's presence in East Asia.[21]

Unlike the Russia and China players, the Southwest Asia and India players made small attempts to adapt to and mitigate climate change. The Southwest Asia player invested in water stress adaptation, and the India player tried to reduce emissions by investing in renewable energy. Their efforts, however, were quickly negated by the lack of investment in emissions reductions by the players whose countries had emitted greater amounts of greenhouse gases.

While China and Russia's players were focusing their attention on matters that would benefit them, the European Union and United States players initially took on the majority of foreign aid and food and fuel security needs. The other players contributed little to these aid efforts, choosing domestic development over global stability. As the game progressed and the China player continued to make military advancements, the United States player felt the need to match these investments to avoid falling behind. Similar to the progression of Game 3, an arms race emerged. To increase military spending, the United States player revised their foreign aid strategy. Rather than immediately responding to unrest, the United States player waited for the situation to escalate before providing aid. In addition, the United States player deployed forces to the Southeast Asia region in response to the China player's presence in the South China Sea.

Similar to the United States player, the European Union player changed strategies during the game. Initially, the European Union player's actions mim-

icked Games 1, 2, and 3; the player asked others, especially the China player, to engage internationally through foreign aid and climate mitigation and adaptation efforts. But once the United States player changed strategies, the European Union player became an isolationist who gave up on eliminating unrest and mitigating climate change and acted aggressively toward migrants. Arguably, the European Union player, who had been an advocate for cooperation, climate mitigation, and stability earlier in the game, was forced into this extreme position by the other players' choices. Eventually, Game 4 reflected the characteristics of Game 3.

Unlike the participants representing the larger countries, the Southwest Asia and India players made small attempts to adapt to and mitigate climate change. The Southwest Asia player invested in water stress adaptation, and the India player tried to reduce emissions by investing in renewable energy. Their efforts, however, were quickly negated by the lack of investment in emissions reductions by the players that emitted greater amounts of greenhouse gases. Thus, it became evident that leadership of the larger countries might be a prerequisite to effecting larger stewardship activities.

Findings and Risks

Based on the players' decisions and wider discussion during the scenario-planning session, we identified four areas where climate change may affect future outcomes in ways that have not been associated with climate change in the past. We organized these findings based on their prominence in the game and scenario-planning discussions:

1. Climate change may trigger increased nationalism and policies of internalization in developed countries.
2. Large-scale, climate-induced migration and displacement has the potential to impact a country's international policies, economic situation, and other defining cultural attributes.
3. Competition for limited resources may increase as a source of friction and shape policies and international relations.
4. The consensus and control of climate-related technologies may result in an emerging disparity between regions, as not all countries view these technologies in the same way and there is little framework for their use or management.

In this section, we discuss each of these findings in detail, first by linking them to player decisions and game play, then by incorporating the points raised during the scenario-planning session, and finally, by stating why we feel there is a risk associated with each finding.

Nationalism and Governance

In all four games, policies of internalization surfaced. In each game, at least one player, and up to five players in some games, decided to put forth nationalistic policies when running his or her country or region. These players did this to concentrate on internal problems as climatological conditions worsened. Players who internalized their efforts felt that their national goals, objectives, and citizens were more important than providing aid to regions in need. In one game, the player representing India invested solely in their country's energy, water, and military security for several decades, ignoring the needs of other regions in the world. In multiple games, players representing China refused to provide foreign aid out of concern that they could not satisfy domestic consumption of food and fuel. Other than some of the European Union and the United States players, the remaining players generally demonstrated only two exceptions to nationalistic behavior: (1) support to neighboring countries and (2) support to spheres of influence.

Most of the players representing the European Union and the United States consistently invested abroad through foreign aid and occasionally through military intervention to quell terrorism. In one game, for example, the European Union player deployed military forces to North Africa to fight terrorism and insurgents. In general, the players who offered foreign assistance seemed to limit their aid to neighboring countries or regions within their spheres of influence, especially to nations that could provide resources or other benefits to the main player. In one game, an India player provided foreign aid to stabilize neighboring Bangladesh out of fear of cross-border migration and terrorism. The European Union and United States players also showed favoritism toward neighboring regions and those within their spheres of influence. In one game, a player representing the United States provided foreign aid to the Andes region, citing the region's natural resources and proximity to the United States as the reason for the aid.

The overall trend of internalization was present throughout most games and was exacerbated when the climate worsened. Many of the players had to deal with growing internal instability as climate change and high temperatures affected food and water supplies. In addition, many of the less-developed countries began to slip into a cycle of disruption, which in turn, generated security challenges, an increasing number of migrants, and economic displacement for players representing developing countries.[22] Eventually, the stress from significant climate change, combined with the increasing and incessant demands from failing states, led to a retrenchment among players. In one game, for example, the player representing Southwest Asia originally contributed to international aid efforts but eventually withdrew its support when it faced regional unrest.

Overall, the players in the games attended to their domestic needs first,

despite the state of the world. As a result, instability that could not be resolved by a single player was a constant factor across all four games. While global stability could have been accomplished through international cooperation and consistent distribution of aid, most players did not turn to traditional, international governance structures to achieve this goal. Participants in all four scenario-planning discussion groups conferred with each other about this potential rise of nationalism and shift in governance, raising concerns about the possibility of needing to change governance structures as a result of added pressures and nationalist policies.

Participants highlighted several possible changes to existing governance structures that could occur as a result of the inability of these structures to resolve global challenges: the failure of regional or global arrangements, such as the European Union; the failure of individual states; and the rise of nonstate actors, such as private corporations. In the case of the European Union, multiple participants during the scenario-planning session hypothesized that the stresses of migration, energy, security, and climate impacts could push some countries in the European Union toward policies of nationalism. Participants suggested that such actions would lead to the disaggregation of the European Union. As for possible nonstate actors, participants in the scenario-planning session discussed that private corporations typically operate in their own interests, and suggested that corporations may be one of the biggest influencers of climate-related decisions in the future. In addition, they highlighted the fact that many private corporations employ highly trained security providers.[23] Given how many private corporations combine economic influence and military-like security, some participants identified private corporations as potential nonstate actors who could rise up as the result of failing states.

Based on game play and the discussions that came out of the scenario-planning sessions, we saw the potential for climate change to affect the way that countries govern and think about human rights and social justice. We identify these factors as big risks since they are something that people do not anticipate, and they have the potential to lead to additional conflict and suffering. The assumption that a major power, such as China, the European Union, or the United States, will come to the aid of those regions in need may no longer be valid if climate change causes a shift in a country's international policies. Two potential reasons that may prevent them from providing aid to foreign regions are that they may be overwhelmed by the volume of aid required or they may face internal instability. In addition, the emergence of new government structures, resulting from either the failure of global arrangements or the failure of the states themselves, could impact available aid. As the need for foreign aid increases and the number of countries that are able and willing to provide sup-

port decreases, difficult decisions will need to be made regarding which regions will receive aid and which will not.

Migration and Displacement

Migration and displacement surfaced in all four games, and these topics were discussed in all of the scenario-planning sessions. In the games, migration and displacement were caused by various factors including, but not limited to, food shortages, water shortages, and financial instability, all of which generated unrest. When there was sufficient unrest in a country, people would migrate.[24] Some examples of migration in the games were people moving from Bangladesh into India, from Central and South America to the United States, and from Africa to countries in the European Union. Climate change contributed to the increase in migration during the games because, as the temperature rose, there was greater food and water insecurity.

As we saw with foreign aid in the previous section, there was little to no cooperation or negotiations between players to resolve migration or displacement. Players whose countries were affected by migration had a decision to make: would they reallocate resources away from national goals or international outreach efforts, seek other means of dealing with migrants, or ignore the issues caused by migrants and allow unrest to spread?[25] Players chose different paths depending on the availability of resources and how they thought their country would react to migrants. The majority of the time, these decisions were made in isolation and without assistance from other players.

Not only did players tend to make decisions in isolation, they vacillated between domestic and international actions based on the needs of their nations. Early in the games, players tended to focus on internal matters before shifting their attention to foreign aid requirements. When outside regions experienced food and water insecurity, and players failed to mitigate shortages, these insecurities led to unrest, which eventually led to migration. This migration then imposed costs on the receiving countries, which had to provide additional food, water, and shelter. Around the midpoint of many of the games, the demands of migrants resulted in the retrenchment and increased isolation of many of the players representing developed countries. This may be the most significant result we saw in the games because it suggests that, as climate change grows more severe, isolation and retrenchment among the richest parts of the world could increase dramatically.

Migration clearly had an impact on the players of the game, and participants in the scenario-planning sessions also broached the issue. They voiced concerns about the potential for unrest and violence caused by anti-immigration sentiments and xenophobia, citing that large influxes of migrants could result

in significantly different social norms and cultural clashes. Participants also expressed concern about the ability of countries to provide the necessary resources for migrants.

As a result, we identified migration as a significant security risk since migrants, both internal and external, affect the economics, religion, and politics of their adopted countries. Economically, an influx of migrants increases food, water, and shelter requirements, imposing greater financial burden on the government. As we saw in the games, such pressures destabilize countries because they are often unable to provide services to the increasing number of migrants. We also saw some countries internalize by either decreasing foreign aid or by closing their borders to maintain stability.

From religious and political perspectives, participants in the scenario-planning session discussed how differing views may lead to the emergence of rogue states, alter the composition of states, or cause a shift in governance. This could result from the actions of migrants themselves or from terrorists and insurgents who take advantage of migration to carry out acts of violence that further destabilize regions and delegitimize governments. These actions could cause a shift in the cultural and social dynamics of a state. Countries with the means to assist incoming migrants, whether through financial aid or opening up of borders, may choose not to do so because they fear internal economic, social, or political instability.

Resource Competition

We identified the competition for resources and the means by which states attempt to meet their needs as a security risk for multiple reasons. First is the increasing divide between the haves and the have-nots. Presently, many countries are resource insecure. Due to climate change, the situation in those countries will likely worsen, leading to further destabilization of states. In comparison, many countries that are relatively resource stable may be less likely to feel severe consequences from climate change. In all four games, meeting food, energy, and water requirements was a major concern for players. In the early stages of game play, resource shortages plagued regions that were already resource insecure. As each game progressed and temperatures increased, more players faced issues related to water scarcity, the availability of arable land, and increasing energy requirements. The idea that already resource-scarce areas will feel the effects of climate change first reinforces the potential for an increasing divide between regions with sufficient resources and those without.[26]

The second reason is the potential for countries to depend on global markets to meet domestic resource requirements, which is problematic considering future constraints may be placed on global markets due to climate change or geopolitical tensions. As discussed during the scenario-planning session, there

is the potential for negative consequences on countries that depend on global markets to meet domestic needs if the markets fail. Many players chose to internalize to stabilize their countries. In some of the games, players who faced shortages chose to invest in engineered crops, water conservation technologies, and exploiting the Arctic for natural resources (i.e., minerals), but generally, the players were unwilling to share resources. In only one game did players agree to an alliance over sharing resources; however, their mutual cooperation only lasted for a few turns of the game.

The third reason is that the potential competition between countries and regions over natural resources is also a risk. Declining availability of raw materials, food, and water could increase tensions and energy disputes between countries attempting to obtain or fighting to maintain control over these resources. Such disturbances would be comparable to those currently taking place in the South China Sea. Rising global temperatures may threaten food and water resources as well as arable land around the world. Without sufficient resources, there is the potential for state instability and even failure. Interestingly, we did not see any players use military force to invade a region and gain control of the region's resources. In only one game did players come close to outright aggression when those representing the United States and China competed for Brazilian mineral rights to meet domestic consumption. The players chose not to use military force, but did commit substantial financial resources to gain access and control.

Finally, in multiple scenario-planning discussion groups, participants identified the potential for competition over natural resources, both nationally and internationally, as an area of concern and possible risk. They reinforced the issue of the widening divide between the haves and the have-nots that we saw in the game; for example, players closed their countries' borders and were less inclined to provide support to regions in need. Many of the "have" players did not make any attempts to mitigate this widening divide. Participants expressed concern about the limited availability of raw materials, food, and water, which they felt could increase tensions and energy disputes between areas as countries fight to obtain or maintain control over these resources. Participants in the scenario-planning sessions also highlighted the potential for countries in need to rely heavily on markets, particularly food markets, to meet their requirements. They stated that if there were fluctuations in the market or if the markets failed completely, it could result in major repercussions for those states that depend on them for resources. Participants noted that the failure of markets, in combination with the already short supply of resources, could lead to state failure. In real time, these are consequences that should be taken into consideration by nations as they examine their policies regarding climate change, humanitarian aid and disaster relief, and overseas investments.

Consensus and Control of Technology

In response to climate change, we saw two of the four games turn to technology to deal with rising temperatures and greenhouse gas emissions. The two dominant forms of technology across the games were nuclear energy and geoengineering. Both of these perceived solutions come with security risks as discussed below.

In one game, the player representing India turned to nuclear energy to reduce greenhouse gas emissions. The players in this game felt it was a viable alternative to fossil fuels. The European Union player supported the India player's actions by investing in nuclear energy. Unfortunately, as we saw in numerous games, the actions by one or two players were not sufficient to offset global emissions and, as a result, global temperature continued to rise.

The continual rise of temperature and increasing severity of climate change in the games also drove some players toward geoengineering, which one set of players saw as a first choice while most saw it as a last resort. All of them were balancing the perceived risks from geoengineering with the increasing risks from loss of governance, national isolation, and resource depletion (e.g., food, energy, and water). About the time that donor fatigue began setting in, these risk curves crossed and geoengineering became more attractive despite the defined risks that were incorporated into the game. Not all players in the games were comfortable with the use of these technologies, specifically geoengineering, since the costs, benefits, and risks are not well understood. Players with technical expertise, however, felt that the benefits outweighed the risks and they proceeded with implementation in those games.

Questions over the control, use, and implementation of geoengineering also surfaced during the scenario-planning discussions as participants echoed the concerns that had been raised during the games. During the scenario-planning session, participants were less concerned about the impacts of increased nuclear energy than those attributed to geoengineering. They did, however, acknowledge that nuclear energy could be weaponized by terrorists or nation states. Furthermore, as demonstrated by the Fukushima nuclear power plant meltdown caused by a tsunami in 2011, nuclear power plants are still vulnerable to accidents.

While the risks associated with implementing technologies, such as geoengineering, are largely unknown, we observed a potential risk related to governance. In the games where geoengineering was implemented, players discussed who had the authority to approve the use of this technology and what requirements should be in place before the technology can be used. Interestingly, geoengineering was one of the few examples that brought the players to engage in multilateral decision making in one of the games. There was, however, a lack of consensus and control surrounding geoengineering elsewhere. This lack of

consensus and control over the use of technologies is a potential security risk. As we observed in the games, without guidance from the international community, nothing prevents a country, region, corporation, or individual from attempting to implement this technique. As climatological conditions worsen, these entities may take it upon themselves to implement this technique with or without approval. Then, it would be incumbent upon all the countries to maintain this geoengineering effort for fear of backsliding.[27]

Conclusion

The four findings and risks highlighted in this article capture some of the big issues that could arise as a result of climate change. We saw interplay between nationalism, limited resources, the possibility of failing states, and the authority to act. The combination of four games and four scenario-planning discussion groups provided an opportunity to identify and discuss the risks that climate change poses to human security. The structure of the event gave participants a chance to discuss various circumstances and identify issues by hypothesizing in a structured environment. The experience and knowledge of the high-ranking participants from different countries was integral to the event and allowed us to explore the foremost climate-related risks. As a result, participants created a virtual world wracked by extreme weather, surging migrant groups, unclear nation agreements, and possible terrorist activity to help policy makers understand the consequences of various actions. Considering that global leaders are already dealing with these conditions piecemeal, the outcomes are plausible and useful for policy makers considering future action.

As the effects of climate change increase, some countries may begin to internalize and put forth nationalistic policies; however, countries that do not internalize may find themselves responsible for aiding larger regions around the globe. Eventually, there may be insufficient resources to support regions in need. Participants suggested that stretching resources too thin may result in an emergence of new government structures, resulting either from the failure of global arrangements or from the failure of the states themselves. Internal and external migration has the potential to change the way that countries operate, how their people view the world, and how their leaders respond to crises. The impact on a particular country or region's outlook toward the global commons, its neighbors, and its own people may have negative consequences for humanitarian aid, security, and the ability to mitigate and adapt to climate change.

In the future, limited resources—food, energy, and water—may force countries and regions to seek alternative pathways to meet their needs. Two such pathways are relying on global markets and assuming policies of internalization, both of which have underlying risks.

As the pressures from climate change increase, countries, regions, organi-

zations, or individuals may turn to such technologies as nuclear energy and geoengineering to mitigate the effects of climate change. Without consensus and control from the international community on managing these and other new technologies, these techniques could be implemented before their effects—both intended and unintended—are fully understood.

Today, these risks may not seem like risks at all as we have yet to feel their impact. However, as the global temperature increases and climate conditions worsen, countries and regions may feel, as indicated by this research, an increased pressure to take action. By recognizing these risks today, countries and regions can be prepared to mitigate these effects in the future. Solutions to the challenges posed by these risks and identifying ways to work through them may not be immediately obvious and could take time to develop. By taking action now, whether it is to better understand the consensus and control of technologies or to mitigate climate change itself, we may be better prepared for the future. While not all of these risks are of immediate concern, decisions made today will drive the pathways we are able to take in the future.

Notes

For the purposes of this discussion and to align with the goals of the game scenario, we use gender neutral pronouns (e.g., they, their) throughout.

1. David King et al., *Climate Change: A Risk Assessment*, ed. James Hynard and Tom Rodger (Cambridge: Centre for Science and Policy, 2015), http://www.csap.cam.ac.uk/media/uploads/files/1/climate-change--a-risk-assessment-v10-spreads.pdf.
2. For additional information on gaming, see David Michael and Sande Chen, *Serious Games: Games that Educate, Train, and Inform* (Independence, KY: Cengage Learning, 2006).
3. Given the importance of the event and seniority of the participants, CNA executed a test run of the game and scenario-planning sessions at CNA Headquarters in the Washington, DC area on 12–13 February. Fourteen people, including representatives from CEEW, FCO, and SGTF as well as subject matter experts, participated in the test run.
4. The phrase *peer competitor* is a U.S. expression that refers to the group of advanced, nuclear-capable countries that can sustain high-intensity combat operations.
5. In the games where geoengineering was implemented, we assumed that it was done in the form of stratospheric aerosols that had to be continuously implemented and maintained throughout the game to sustain the effects.
6. Migrants in the game represented millions of displaced persons occupying a large area and consuming considerable resources. In the game, we did not differentiate between migrants and refugees. "Migrant/Migration," United Nations Educational, Scientific and Cultural Organization (UNESCO), 21 October 2015, http://www.unesco.org/new/en/social-and-human-sciences/themes/international-migration/glossary/migrant/; and "Refugee," UNESCO, 21 October 2015, http://www.unesco.org/new/en/social-and-human-sciences/themes/international-migration/glossary/refugee/.
7. For an in-depth discussion of the different Intergovernmental Panel on Climate Change's (IPCC) emission pathways, please see Matthew Collins et al., "Long-Term Climate Change: Projections, Commitments and Irreversibility," in *Climate Change 2013: The Physical Science Basis*, ed., Thomas F. Stocker et al. (Cambridge: Cambridge University Press, 2013), 1029–1136; IPCC, "Summary for Policymakers," in *Climate Change 2013*, 3–32; and

IPCC, "Annex II: Climate Systems Scenario Tables," in *Climate Change 2013*, 1395–1446.

8. A turn represented a step in time. During a turn, all the players would have to make certain decisions simultaneously, which is discussed in additional detail later in the article.
9. One game controller was assigned to each of the four games to walk players through each turn, answer questions, capture the players' decisions, provide outcomes of those decisions, and fulfill a few other responsibilities during the game.
10. "Quick Facts: What You Need to Know about Super Typhoon Haiyan," *MercyCorps*, 14 November 2013, https://www.mercycorps.org/articles/philippines/quick-facts-what-you-need-know-about-super-typhoon-haiyan.
11. Elizabeth Frankenberg, Duncan Thomas, and Jed Friedman, "Resilience and Recovery Ten Years after the 2004 Indian Ocean Tsunami: A Summary of Results from the STAR Project," *Impact Evaluations* (blog), World Bank, 18 December 2014, http://blogs.worldbank.org/impactevaluations/resilience-and-recovery-ten-years-after-2004-indian-ocean-tsunami-summary-results-star-project; and David R. Marples, "Chernobyl," Encyclopedia of Russian History, 9 June 2016, http://www.encyclopedia.com/topic/Chernobyl.aspx.
12. The simplified relationships between climate and resource variables used in the game model were reviewed by the Climate Change Science Institute of Oak Ridge National Laboratory. Sylvia Lee, e-mail to Simon Sharpe and Jay Gulledge, 25 February 2015.
13. "World Factbook, 2013–14," Central Intelligence Agency, 4 June 2015, https://www.cia.gov/library/publications/the-world-factbook/index.html; "World Bank," World Bank, 31 December 2014, http://www.worldbank.org/; and "World Population Prospects: The 2012 Revision," UN, Department of Economic and Social Affairs, Population Division, 4 June 2015, http://esa.un.org/wpp/.
14. Collins et al., "Long-Term Climate Change"; IPCC, "Summary for Policymakers;" IPCC, "Annex II: Climate Systems Scenario Tables"; Claudia Tebaldi et al., "Going to the Extremes: An Intercomparision of Model-Simulated Historical and Future Changes in Extreme Events," *Climatic Change* 79, no. 3 (2006): 185–211, doi:10.1007/s10584-006-9051-4; "World Statistical Data," FAOSTAT, Food and Agriculture Organization of the United Nations Statistics Division, 4 June 2015, http://faostat3.fao.org/home/E; Katy Richardson, *Human Dynamics of Climate Change: Technical Report* (Exeter, UK: Met Office, 2014), http://www.metoffice.gov.uk/media/pdf/n/d/HDCC_technical_report.pdf; Charles J. Vörösmarty et al., "Global Water Resources: Vulnerability from Climate Change and Population Growth," *Science* 289, no. 5477 (2000): 284–88, doi:10.1126/science.289.5477.284; Kate Gordon, *Risky Business: The Economic Risks of Climate Change in the United States* (New York: Risky Business Project, 2014), http://riskybusiness.org/site/assets/uploads/2015/09/RiskyBusiness_Report_WEB_09_08_14.pdf; "*Human Development Index (HDI)*," UN Development Programme, 3 June 2015, http://hdr.undp.org/en/content/human-development-index-hdi; and IPCC, "Summary for Policymakers."
15. Because water variability ranges from drought in some parts of the world to flooding in others, we characterized water variability as a measure of these swings in water effects.
16. The climatological conditions described in the materials were mainly based on the IPCC's fifth assessment report and related research documents cited earlier. The assumptions used in the scenario-planning session documents were reviewed by the Climate Change Science Institute of Oak Ridge National Laboratory. See Lee e-mail.
17. This test run was executed over two days, but we ran two separate player groups through the game and held two scenario-planning sessions rather than four.
18. Players could propose other investment options if they wished.
19. There was a mutual agreement among these players as to which regions they would provide assistance.
20. In the game, when players wanted to implement geoengineering, they had to roll the dice to account for the potential of unintended negative consequences. Players had a 5 percent chance of their implementation going awry. Since stratospheric aerosols have

to be continuously implemented, the implementing player had to roll every turn to see if there were any negative consequences, thus increasing the nation's probability to suffer risks.

21. Given the United States' relationship with Japan and other East Asia countries, the U.S. player had military forces in East Asia as part of the starting conditions of the game.
22. In the game, some of the countries and regions were in a state of constant unrest, which occurred when the players did not continually mitigate issues that arose.
23. Group 4 Securicor (G4S), for example, is the largest security solutions provider in the world; it operates in more than 110 countries. "Key Facts and Figures," G4S, 1 June 2015, http://www.g4s.com/en/Media%20Centre/Key%20facts%20and%20figures/.
24. As part of the game mechanics, when a migrant relocated to a given player's country, the country saw increased costs and unrest.
25. As part of the game mechanics, if players did not mitigate the issue causing the unrest, the unrest would continue to grow and spread. Similarly, if the issue causing the unrest also caused people to migrate, additional migrants would be generated until the issue was resolved.
26. Recall in Game 3, for example, the Southwest Asia player did not have sufficient food resources to meet their needs and therefore threatened to invade North Africa if they did not receive assistance.
27. Assuming geoengineering is implemented through the use of stratospheric aerosols, it must be continuously maintained. There is the perceived risk that if these aerosols are not sustained, global temperatures could rebound or rise even higher.

The Greening of the U.S. Military: Environmental Policy, National Security, and Organizational Change. By Robert F. Durant. Washington, DC: Georgetown University Press, 2007. Pp. 320. $31.95 (paperback and e-book).

In *The Greening of the U.S. Military*, Robert Durant, professor of policy at American University, provides a carefully researched investigation of environmental politics in the post-Cold War era and how the armed forces of the United States have responded to external pressures promoting more responsible environmental and natural resources (ENR) policies. While climate change and other environmental issues have gained considerable public policy focus in the years since the book's release, Durant's work nonetheless stands as an important snapshot in time, especially his analysis of the transition from a Cold War-minded defense establishment to a post-Cold War military that is politically conscious and developing technologically. Durant turns away, however, from the purely historical exercise of exploring how the U.S. military has engaged with greening initiatives over time to the more practical task of evaluating the theoretical and policy-making lessons this history provides. This approach is apparent from the stated purpose of the work, which Durant says is to understand how "well or ill suited the military's reactions" were to promoting a fair deliberative forum for debating ENR policies. Ultimately, Durant argues that as a result of Cold War-era resistance to external greening initiatives, the post-Cold War era has been characterized by confusion in both military and government leadership in regard to the success of greening efforts as well as a haphazard approach to ENR objectives (p. 4).

The theoretical foundation of Durant's work emerges from the second half of the first chapter, where he lays out the various fundamental theories engaged elsewhere in the work. Not for the general reader, this discussion identifies important theoretical perspectives on large-scale organizational change, such as the significant transformation represented by the greening of the U.S. military. Moreover, Durant highlights that scholarship on the policies and theories of public organizations and the military are particularly scarce, providing

both the opportunity and need for his current work. With this established, Durant explains that a study of the U.S. military's greening efforts in the post-Cold War era from a "polity-centered perspective of large-scale change" is promising, especially when considered alongside the specific strategic, tactical, and operational decisions of the post-Cold War period. Durant then presents a more complete understanding of the military's involvement with ENR policies at the time, offering lessons for future policies and theoretical applications (pp. 18–19).

The body of Durant's work includes a detailed discussion of civilian-military interactions regarding cleanup efforts, waste policies, military training, demilitarization of chemical weapons, pollution prevention and energy conservation, trends in national politics, and finally lessons for theory and practice. In each case, Durant examines the political momentum of, and support for, ENR reform in conjunction with the military's willingness or reluctance to take reformative action.

An example of this process can be found in the third chapter, where Durant demonstrates how traditional military attitudes toward inter-Service cooperation and unofficial opposition to joint efforts was an obstacle for ENR reform. Even though "jointness" of military operations had been an objective of military planners since the unification of the armed forces in 1947, parochial attitudes and inter-Service rivalry had often prevented successful implementation of these ideals. Unfortunately, the military of the post-Cold War era also was plagued by these issues, preventing a straightforward adoption of ENR policy across the various branches of the military (pp. 53–58).

The persistence of historical-structural attitudes as outlined above became the first phase of what Durant terms a trajectory of contestation in post-Cold War ENR reform. It was followed, however, by several other phases that ultimately produced very little, if any, effective change in military attitudes toward greening. Durant follows these phases in case after case, highlighting a pattern of response that frequently characterized interactions between stakeholders in the military, government, and politics regarding greening initiatives. Specifically, Durant argues that repeating patterns of historical-structural conflict, offensives and counteroffensives, crises of authority, and consolidations combine to form a larger trajectory of contestation in civil-military ENR efforts. This pattern of response is discernible in each of Durant's examples, from base transfers to ordnance waste management, military training, and chemical weapons demilitarization.

Ultimately, Durant observes that no meaningful change occurred from the end of the Cold War through the William J. "Bill" Clinton years and the turn of the century. Shifting political winds, questionable bureaucratic practices in the

military, and the complexity that the confluence of these issues and ENR objectives produced proved too large of a problem. Durant, nevertheless, makes the case that such intransigence could no longer dominate civil-military ENR cooperation. Instead, ENR goals and national security objectives had to be made compatible, and the figures involved must engage and cooperate under the realization that much depends on their collaborative success.

Though certain developments have taken place since Durant's analysis, the book must be valued for the perspective it provides. It is, indeed, an exploration of the beginning of transition that has continued throughout the Barack H. Obama administration and will continue to be a part of U.S. military policy in the years to come. For those interested in reading more recent works, see Rita Floyd's *Security and the Environment: Securitisation Theory and US Environmental Security Policy* (2014); Edwin A. Martini's *Proving Grounds: Militarized Landscapes, Weapons Testing, and the Environmental Impact of U.S. Bases* (2015); and Struan Stevenson's *Stalin's Legacy: The Soviet War on Nature* (2012). These authors explore military and environmental policy with an eye toward the Cold War or post-Cold War developments, adding to the conversation Durant broached in 2007.

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Light It Up: The Marine Eye for Battle in the War for Iraq. By John Pettegrew. Baltimore: Johns Hopkins University Press, 2015. Pp. 240. $34.95 (cloth).

Light It Up is a fascinating historical assessment of the role of visual culture in the production of American military violence in the early twenty-first century. Concentrating exclusively on the Marine Corps, Lehigh University historian John Pettegrew contends that a cultural framework of optics, or "techniques of violence located in the eye and expressed through skills of killing from a distance," motivated and shaped the Marines' practices of warfighting during the Iraq War (p. 3). The book reveals individual Marines' experiences of warfare in Iraq, while raising important questions about the decision-making processes and ethics implicated in reflexively shooting to kill.

To examine the ways in which the Marine Corps projected military force in Iraq through the optics of combat, Pettegrew exploits an array of sources, including oral interviews, war memoirs, news articles, military reports, field manuals, recruitment commercials, films, documentaries, video games, and

YouTube combat footage. These diverse sources permit Pettegrew to construct a history that is primarily cultural, but also partly institutional. The author discusses his sources and methodologies in the introductory chapter, but also provides a brief appended essay discussing the book's key primary sources and interpretive methods.

Pettegrew explores the optical dynamics of warfighting during Operation Iraqi Freedom by analyzing both vision-based technology and the processes by which twenty-first-century media and the Marine Corps' institutional imperatives combined to fashion "an eye for battle" among young Marines, especially infantrymen (p. 38). Although technologies, such as the advanced combat optical gunsight, enhanced Marines' target identification and hit probability, Pettegrew posits a direct relationship between aspects of Corps culture and training—for instance, the constant use of expressions such as *kill* and *slay bodies* to acknowledge orders, greet superiors, or communicate motivation—and the near-instinctive commission of battlefield violence during the opening phases of the operation. Building on the work of scholars, such as Paul Virilio and Jean Baudrillard, he argues that war films, television programs, and YouTube videos featuring the Marine Corps in combat both elicited a desire for violence and registered the pleasure that many Marines experienced during military operations in Iraq. Pettegrew approaches this media genre as "war porn," emphasizing what he identifies as its evident similarities to sexual pornography (p. 40). Some readers may find his definition of war porn too expansive, even encompassing a number of World War II-era films.

The author's analysis of Marine-focused combat footage posted to YouTube and other video sharing websites is especially thought provoking. Perhaps the most obvious example of war porn, these videos were shot by Marines in combat and frequently overlaid with metal or hard rock audio tracks. While such videos show the ferocity and devastation of urban warfare in Iraq, enthusiastic and sometimes sexually explicit comments from viewers with usernames such as MarineCorpsMarksman, MarineTroopSupport, WilcoUSMC, and Marines137 allow Pettegrew to argue that they "work pornographically, fetishizing the action of eliminating Orientalized others" (p. 53). He acknowledges the problems of using viewer commentary as a primary source, but maintains that commonalities among several hundred comments permit historians to deduce meaningful interpretive conclusions regarding the impact of war porn on servicemembers who consume it.

Highly adaptable video gaming and simulation played an important role in readying Marines for combat, signifying the extent to which virtual war and actual war have merged. Pettegrew stresses that more than 40 Marines from 3d Battalion, 1st Marines, helped Destineer Corporation create the first-

person shooter video game, *Close Combat: First to Fight* (2005), by demonstrating fireteam tactics and describing the sights and sounds of urban combat in Iraq. Destineer production teams also visited Marine bases and studied the Corps' warfighting doctrine. He finds that violence was built into *First to Fight*'s "very ontology," as the game allowed "no computation for empathy let alone nonlethal engagement" (pp. 93–94).

The dichotomy between instinctive killing and empathy is explored in a chapter on the Marines' shift to a counterinsurgency strategy in Iraq's vast al-Anbar Province from 2004 to 2007. Pettegrew quotes the commanding officer of 3d Battalion, 5th Marines, who in June 2005 praised his Marines for having "turned off the killing switch" to conduct humanitarian and counterinsurgency operations during the months following their recapture of Fallujah (p. 96). He underscores the complexities and paradoxes of counterinsurgency in an occupied foreign country, where Marines and soldiers had to move instantly from lethal force to compassionate restraint, and then swiftly back to lethal force. For Pettegrew, the killing of 24 Iraqi civilians, including women and children, by enlisted Marines of K Company, 3d Battalion, 1st Marines, at Haditha in November 2005 appears "less an aberration than an unintended yet utterly predictable outcome of the Marines' occupying force amid an insurgency" (p. 106). The carnage of Haditha compelled senior Marine leaders to attempt to refocus the Service's warrior ethos and expand organizational training in cultural awareness and ethical decision making.

The author offers extended discussion of evolving trends in post-human warfighting that seems to rely too heavily on Robert A. Heinlein's 1959 novel *Starship Troopers* and Orson Scott Card's 1985 novel *Ender's Game*, as well as such films as *Avatar* (2009). Unmanned attack vehicles and combat robots, he points out, will amplify the geographic distance of the killer from the killed in future warfare, while autonomous battlebots making life-or-death decisions would "be free of the emotional trigger to noncombatant casualties" (p. 146).

Some readers may feel that Pettegrew overgeneralizes about Marines and their culture, not adequately accounting for the diversity and complexity of the twenty-first-century Corps. Despite the well-known axiom "every Marine a rifleman," thousands of Marines performed combat support and combat service support jobs at some point and were somewhat removed from combat in Iraq, where they were not fully immersed in the "optics of combat" that Pettegrew seeks to elaborate. Overall, *Light It Up* is an ambitious and valuable contribution to emerging historical scholarship on military operations and martial cultures in the early twenty-first century. Pettegrew underscores the complex ways in which cultural frameworks and ethical systems shape military practices, as well

as the brutality and destruction of warfare more generally. The book will appeal to military historians, violence studies scholars, military professionals, and general readers interested in war, culture, and society.

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Clean and White: A History of Environmental Racism in the United States. By Carl A. Zimring. New York: New York University Press, 2015. Pp. 288. $35.00 (cloth).

Racism is a dirty business. Throughout American history, white power has depended upon the portrayal of nonwhites as unclean. In turn, this ever-evolving discourse has reinforced the racial inequalities of the waste-disposal industry. Minority communities are far more likely to become sites for toxic dumping than white neighborhoods, and sanitation workers in the United States are disproportionately African American and Hispanic. In *Clean and White*, Carl Zimring advances these insights and uncovers key turning points in American narratives about racial purity.

Tracing a chronological arc across three centuries, Zimring explores "the social and cultural constructions of race and hygiene in American life from the age of Thomas Jefferson to the Memphis Public Works Strike of 1968" (p. 4). The author, an associate professor of sustainability studies at New York's Pratt Institute, convincingly argues that the tumultuous era after the Civil War was a watershed moment when equations of whiteness and sanitation—and nonwhiteness and dirt—acquired a powerful cultural vocabulary.

Clean and White unfolds in four parts. The first two sections, "Antebellum Roots" and "New Constructions," span the period from the Early Republic to the 1930s. Topics include the development of a pseudoscience that justified discriminatory Jim Crow laws, the emergence of the Ku Klux Klan's terrorism in the guise of a crusade for racial purity, and the marketing of white supremacy in turn-of-the-century soap advertisements. The third and fourth sections, "Material Constructions" and "Assimilation and Resistance," address the ways in which ethnic minorities—from Eastern European Jews and Chinese Americans to Italians and African Americans—became the workforce of the sanitation occupations, the laundry business, and the junk-and-scrap trades during the nineteenth and twentieth centuries. These demographic shifts occurred in the

context of rapidly mutating racial categories. As a result, their study is crucial to our understanding of struggles over cultural identities. In Zimring's words, "Burdens of waste and waste work continued to fall heavily on those who were not considered white, and changing criteria shaping white identity resulted in removing many Americans from the perils of not being white" (p. 136).

Zimring is at his most compelling in the book's final chapter, which chronicles the 1968 Memphis Public Workers' strike. This was Dr. Martin Luther King's final campaign before his assassination, and it marked a transition in the politics of race and waste. After the embattled sanitation workers emerged victorious from their fight for a fair contract, the national landscape of privilege and purity was fundamentally altered. "The illusion of 'clean and white' endured after Memphis, but a new resistance conscious of the illusion's consequences had emerged," notes Zimring (p. 216).

For centuries, whiteness has served as the baseline of purity against which degrees of racial difference have been measured. Books such as Nell Irvin Painter's *The History of White People* (2010) and George Lipsitz's *The Possessive Investment in Whiteness: How White People Profit from Identity Politics* (1998) have exposed the blistering contradictions beneath such claims. Zimring's *Clean and White* augments this important scholarship and offers a welcome supplement to the fields of environmental history and U.S. history and provides a deeper understanding of how racism is embedded in local government and administration.

Despite the book's many virtues, it is not immune to critique. More could be said about American exceptionalism. Are the issues that Zimring so eloquently accentuates unique to the United States or do they characterize other societies and nations? In his conclusion, the author hints at how one might approach such questions, but he never gives readers the broader theoretical and empirical brushstrokes to complete such a picture.

Additionally, the book would have benefitted from a stronger theoretical foundation. Zimring's highly appropriate nod toward Michel Foucault's concept of *biopolitics*, the modern state's extension of power over both the physical and political bodies of a population, deserves greater attention than the one discursive footnote it receives. Likewise, Zimring could have more thoroughly scrutinized the capitalist tendency to understand waste as an "externality." Although such detrimental effects are not reflected in commodity pricing, they have costly repercussions for marginalized communities, exploited environments, and future generations.

These caveats aside, *Clean and White* is a readable and engaging book. Although it went to press before the 2016 water contamination scandal in Flint, Michigan, captured the nation's attention, the book's conclusions are well timed for a historical moment in which issues of environmental racism will increas-

ingly define national debates about the nature of justice and the politics of difference.

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Re-Visioning Terrorism: A Humanistic Perspective. Edited by Elena Coda and Ben Lawton. West Lafayette, IN: Purdue University Press, 2016. Pp. 340. $29.95 (paperback); $14.99 (e-book).

A recent search using the term *terrorism* on Amazon returned 45,336 results, reinforcing what we already know—that there is no shortage of literature on the topic. What there *is* a shortage of, however, is innovative literature that speaks to the complexity and ambiguity of terrorism in creative and dynamic ways; *Re-Visioning Terrorism: A Humanistic Perspective* provides just this kind of engagement.

Encompassing 16 chapters and multiple contributors, the book is divided into four parts, which presents several themes for understanding the topic of terrorism. The authors of Part I, "Approaches to Understanding Terrorism," offer philosophies and theories, while the authors in Part II, "Perspectives through the Ages," rely more on history. Following this discursive context, several writers are then able to dive into issues of policy and politics as in Part III, "America and the War on Terror." For additional breadth and depth, the editors engaged several scholars in Part IV to explore empirical mediums in the "Narrative, Cinematic, and Visual Case Studies." Thus, as a whole, the authors are able to explore, with philosophical nuance, how terrorism is portrayed or reacted to in the products of historians, policy makers, and creators of popular culture. Interweaving these general themes within the specific chapters is a welcomed attention to "humanistic perspectives" that are too often obscured in many terrorism studies, solidifying *Re-Visioning Terrorism* as a strong addition to existing debates.

Editors Elena Coda and Ben Lawton lay out the book's purpose as challenging our assumptions on what terrorism is by having us *re-vision* terrorism in different ways. This re-visioning is explained as a "rack focus response," referring to how a person changes "the focus of a lens such that an element in one plane of the image goes out of focus and an element at another plane in the image comes into focus" (pp. 8, 40). It is an ambitious project that endeavors to connect philosophical approaches, historical engagement, contemporary

political analysis, and creative empirics. In arguments around the consequential interrelation of security and insecurity, this book enables the reader to analyze tensions between terrorism and counterterrorism with a critical eye. This critical eye is what enables the reader to better consider fundamental contradictions as presented by the editors; in this instance, the "main dilemma with the counterinsurgency doctrine is that it requires troops at the same time to destroy the enemy and protect civilians" (p. 14).

As the most conceptual part of the book, Part I begins by engaging French postmodernism with Kenneth E. Noe's use of a Deleuzian lens to encourage attentiveness to moral health (pp. 52–53). Noe underscores the ambiguity of terrorism by using "the event" as a device to tease out how terrorism can represent a physical act and also be open to multiple interpretations. His is a "project for reconceiving the nature of concepts as primarily relational, differential, and productive" (p. 37). Some may view the language as too opaque or some sentences long, but this is outweighed by the importance of challenging "epistemic norms" so often taken for granted. Quite compellingly, and in line with most of the book's chapters, Noe argues "we are looking for those differences that make terrorism terroristic in the first place" (p. 49). Thus, stakeholders can "disclose possibilities for not only combating terrorism through familiar means, but also through activities of resistance that seek to change cultural patterns of thought and behavior," that contributes to conditions that allow for terrorism to emerge foundationally (p. 49). The "Approaches" section continues, with Jonathan Beever, a philosophy professor of ethics and digital culture, who draws on Jean Baudrillard to analyze the symbolic aspect of terrorism and argues for an equally symbolic response. Following this, Hatem N. Akil, English professor and visual and cultural theorist, employs Giorgio Agamben's notion of "bare life" as "a zero point in humanity" to show how a suicide bomber's quest is, in part, to move beyond bare life "to count as human beings" (p. 69). Akil importantly underscores how "categories of human and inhuman" can enable problematic generalizations that target all Muslims as "radicalized and uncooperative," a conclusion deserving of continued research (pp. 70, 80).

Part II brings in the historical perspective, relying on a diverse group of scholars to think about terrorism and counterinsurgency in ancient and early modern periods. It starts with historian Timothy Howe comparing modern counterinsurgency doctrine, known to most as COIN, to Athenian resistance and Macedonian occupation, helping us think about insurgencies and counterinsurgency by examining it in ancient history. Ricardo Apostol, a classics scholar, helpfully disturbs notions of the existence of terrorists as "new" by looking at the Roman example. He notes that "simply because there is no single word or category that fulfills this function does not mean that the Romans did not have other ways of doing the same" and how state counterterrorism "re-

turn[ed] terror for terror" (pp. 121, 125). By analyzing representations of "Crusaders" in historical context, scholar Sarah-Grace Heller uses primary sources to importantly remind the reader of historical uses of terrorism by Western actors, for example, by instilling fear into Syrians "for the pleasure of European audiences" (p. 138). In the final chapter, Guillaume Ansart, a French language professor, focuses on how a French regime of terror was enabled in the name of liberty and equality, providing historical context for how counterterrorism has, in some ways, always been at odds with ideals of democracy.

The editors then move the conversation from the general to the specific in Part III with "America and the War on Terror." This section begins with professor of American studies Louise Barnett explaining that, while COIN may be rational in theory, such rationality is impossible in practice, arguing that "we cannot win the hearts and minds of a populace that is simultaneously being slaughtered by our soldiers" (p. 172). Legal expert Harold Williford argues that extralegal procedures are linked to pre-11 September 2001 counterterrorist fantasies by convincingly investigating the "historical interplay of American culture and counterterrorism" (p. 191). Temporal dynamics are at play in chapter 11 as English professor Todd Kuchta exposes the fascination people have with the post-9/11 present as "new historical reality" (p. 212). His Foucauldian approach complements earlier chapters in how a "history of the present" can help us see how the way things are not the way they were predetermined to be (pp. 224–25). English scholar Stella Setka concludes Part III by focusing on how the Holocaust helps us see the construction of narrative history dynamics as an intersection of event, trauma, fiction, and fact. Thus, Part III helps us challenge assumptions associated with terrorism and counterterrorism in the U.S. context by weaving historical, sociological, and cultural analysis in distinctive ways.

Part IV, "Narrative, Cinematic and Visual Case Studies," provides us with a set of creative empirical studies, especially in terms of understanding the identity of victimhood. Artist and professor Fabian Winkler discusses representations of the Red Army Faction, a left-wing West German group (1970–98), by asking how contemporary art may contribute to "the prevention of sociopolitical trauma caused by acts of terrorism" (p. 243). In chapter 14, Jaume Marti-Olivella, professor of Spanish, asks how film may facilitate dialogue, concluding that terrorist and victim are both silenced and overwhelmed by terroristic violence and counterterrorism discourse. Through the medium of fiction, cultural production, and victim testimonials, anthropologist Roland Vazquez argues that an exclusion of antagonist voices relates to how post-terrorist literature constructs who can and cannot claim victimhood. In the final chapter, researchers Aaron Choo and Wilson Koh examine terrorism from a commercialized perspective by examining how the anime series *Code Geass* re-

jects mainstream assumptions of what "is" with the use of Francois Lyotard's idea of "little narratives" (p. 293). Viewing these chapters together, we can see how Part IV complements the volume as the authors apply nuanced humanistic approaches to analyze specific empirical contexts across diverse mediums.

In summarizing these contributions, we see that *Re-Visioning Terrorism* is anchored by an exploration of terrorism's unavoidable ambiguity: terrorism holds no singular meaning. Thus, in researching terrorism, we must consistently interrogate the space between fact and fiction, between assumed "truth" and ever-present subjectivities. The authors helpfully tackle intersecting issues of philosophical rigor, historical narrative, social construction, and contemporary insecurity—providing an energizing set of considerations moving forward.

While it may have been useful to include a concluding chapter, in reflecting on the editors' statement that "We hope that the kaleidoscopic and antidogmatic approach will help us to shed critical suspicion on any fixed rhetorical construction that claims an absolute understanding of terrorism" and encourage "further research and criticism in the humanities," it is clear that they have met these goals with success (p. 17).

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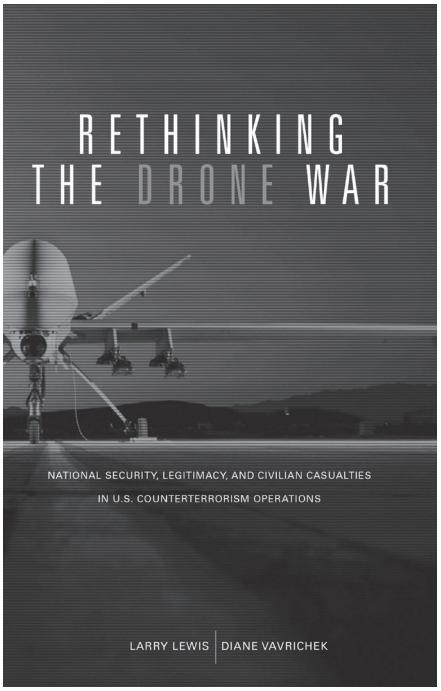
LOOK FOR NEW TITLES IN 2017



Rethinking the Drone War

National Security, Legitimacy, and Civilian Casualties in U.S. Counterterrorism Operations

Larry Lewis and Diane Vavrichek
Paperback.

Rethinking the Drone War focuses on how U.S. national security practices, especially those involving armed drones, have raised numerous questions related to ethics and practicality. This volume is a collection of four reports that collectively address these issues by exploring the themes of legitimacy, civilian protection, and national security interests. Although this volume focuses specifically on current counterterrorism practices, its analysis, frameworks, and conclusions can be applied in varying degrees to emerging technologies as well.

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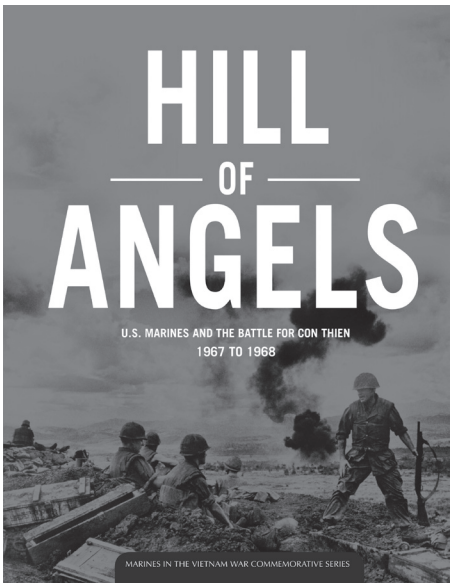

Hill of Angels

U.S. Marines and the Battle for Con Thien 1967 to 1968

Col Joseph C. Long, USMCR (Ret)
64 pp. Paperback.

This study focuses first on the planning and building of the controversial obstacle system of which Con Thien was an anchor. It then examines the period of the battle's most intense combat—beginning in May 1967, when Marines first occupied the hill, and continuing until the early part of the following year.

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