

There's a Pattern Here: The Case to Integrate Environmental Security into Homeland Security Strategy

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ABSTRACT

The time is long overdue to acknowledge that global climate and resource stresses, encompassed by the concept of environmental security (ES), are an increasingly important part of "homeland" security (HS) study and practice, by even the most restricted definitions of HS. Environmental security issues will affect global economic and political stability, US national interests, and the risk of war and terrorism. Just as homeland security encompasses many complex issues and interconnected subfields, environmental security (ES) is interdisciplinary by nature. In essence, ES is an emergent discipline borrowing from a combination of environmental studies – which decades ago integrated environmental science with public policy – and the broader observations of how environmental change, extreme weather events and resource scarcity issues impact domestic and international security. In a two-part argument, we first observe the growing environmental and resource-related security threats at every level of analysis, from global to individual levels as consequences of warming-induced climate alterations. Next, given the significant impacts on local, regional, and international geopolitical stability, we discuss why environmental security threats must be incorporated into both homeland and national security strategic planning. Developing a theory of environmental security seems central to a more complete understanding of homeland security and a more modern concept of national security.

"Make no mistake: without concerted action, the very future of our planet is in peril. ..."

"Lack of action on climate change threatens to make the world our children inherit a completely different world than we are living in today..."

"Climate change is one of the single biggest challenges facing development. ...Unless we take action on climate change, future generations will be roasted, toasted, fried and grilled."¹

INTRODUCTION

In July 2012, amidst the hottest year recorded up to then in the continental United States, with an extended, record-breaking heat wave across the country, the Southwestern United States at risk of becoming a new drought-ridden "Dust Bowl",² historic wildfires raging in Colorado,³ and in the aftermath of a destructive multi-state "derecho" storm,⁴ Department of Homeland Security (DHS) Secretary Janet Napolitano made a link between the severe weather events and climate change. "You have to look at climate change over a period of years, not just one summer," Napolitano said. "You could always have one abnormal summer. But when you see one after another after another then you can see, yeah, there's a pattern here."⁵ Four months later, "Superstorm" Sandy – one of the most expensive natural disasters in US history – devastated the Northeast seaboard.

The DHS secretary's observation was certainly warranted at a scientific level. Climate scientists many years ago reached a *scientific consensus* that anthropogenic global warming and climate change, largely caused by human greenhouse gas emissions, is occurring.⁶ Global warming is the build-up of heat trapped in the atmosphere, land, and (90 percent or more) oceans as the direct

result of a magnified greenhouse effect that traps more solar energy than normal.⁷ Climate change is the often disruptive and regionally variable result of that build-up of heat. Global warming contributes to changes in extreme weather events and long-range precipitation, heat and cold variations, ocean level rise and growing carbon-related ocean acidity, melting of massive polar ice reservoirs and frozen permafrost, and a host of other effects.⁸ But because of well-established scientific cause and effect, both are at once dependent and independent variables, critical and inseparable in analysis of the environmental, national, and homeland security implications discussed below.

Scientists have for decades been predicting extreme weather events as well as changes in regional and global climate would increase in response to human-caused (i.e., anthropogenic) warming, and begun to directly tie some specific recent extreme weather events to climate change.⁹ After generations of denial by the fossil fuel industry, even the CEO of Exxon Mobil, Rex Tillerson, acknowledged in the summer of 2012 that *human-caused* climate change is happening. Sadly in these same guarded remarks Tillerson suggested that responding to climate change would not require changes in current policy or consumption patterns. Tillerson characterized global warming as a solvable “engineering problem,” and insisted that, whatever problems arise from resulting climate change, “...we’ll adapt to that.”¹⁰ What was notable about Janet Napolitano’s comments was her public (if oblique) recognition that DHS, as the primary manifestation of federal homeland security efforts, was concerned about the long-term environmental security consequences of climate change and the disasters that could result from it.¹¹

And yet, but for the fractured American politics of climate change, Napolitano’s observation should have long ago been obvious in the national public policy debate. Nonetheless, the scientific and the institutional affirmation of this growing security problem has been accelerating. As far back as the 1950s, thanks to extensive scientific research on carbon dioxide (including groundbreaking civilian studies¹²

as well as military research) the basic facts about human carbon dioxide (CO₂) were already established. Even the Pentagon knew that atmospheric CO₂ and water vapor blocked heat, and thus could act as greenhouse gases, after extensive studies on the effectiveness of heat-seeking missiles.¹³ This research on those and other heat trapping “greenhouse gases” was confirmed by additional research and beyond a reasonable doubt over the subsequent generations. And analysis of the composition of Earth’s principal greenhouse gas – carbon dioxide – the carbon fingerprint, as such, has clearly shown that the majority of atmospheric CO₂ is comprised of particular isotopes derived from the human burning of fossil fuels, and not from natural sources.¹⁴

Given the scope of its implications and the international nature of its drivers, climate change is among the most important issues of our era.¹⁵ There is an overwhelming scientific consensus among experts on the basic causes and realities of climate change and global warming; although, in political rhetoric mostly confined to the United States, there remains a modicum of dissent¹⁶ –enough to paralyze most significant policy measures aimed at greenhouse gas emissions reduction.

Although there are still some uncertainties (decreasing every year) about exactly what, where located, and how severe the consequences will be, current patterns of climate change are sobering. The basic facts of climate change have long ago been put to rest in the scientific and political debate in most of the developed world, despite the political failure in America to ratify international climate response treaties.¹⁷ For example, a 2009 survey of over 3,000 earth scientists asked the question “Do you think human activity is a significant contributing factor in changing mean global temperatures?” Although 82 percent of those surveyed answered affirmatively, significantly 97.5 percent of climatologists who actively publish research on climate change responded affirmatively. As the study authors noted, “...the debate on the authenticity of global warming and the role played by human activity is largely nonexistent among those who understand the nuances and scientific basis of long-term *climate* processes.”¹⁸

This paper is organized in two parts. In Part I we develop the case for greenhouse gas-induced global warming and resultant climate change and its ties to homeland (and national) security, economic security, and human/public health security. Note this part will not include a thorough review of the science of climate change, for that has been well documented. Rather, Part I outlines recent studies among the most important American and international science, policy, and security institutions in order to begin to better establish the many and deep ties between climate change and security. These demonstrate the ominous existing – and potentially calamitous future – results of anthropogenic climate change. Part II specifically develops the concept and scope of the emergent discipline we call “environmental security,” (ES). Here we make the case that climate change is inextricably linked to both public health and economic wellbeing, and therefore is a bona fide homeland security concern worthy of integration into HS strategic planning processes and mission statements. Ultimately, adequate assessment of both domestic and international security risks, including proper development of mitigation strategies, cannot be done without incorporating the consequences of global climate change or resulting conflicts that arise from resource scarcity. That is, from a strategic planning perspective, a comprehensive view of national or homeland security cannot be constructed without incorporating the precepts and drivers and mitigating factors of environmental security.

THE CASE FOR ANTHROPOGENIC CLIMATE CHANGE AS A SECURITY ISSUE

Why has environmental security become part of the national security and homeland security agendas of all nations, including the United States? Until recent decades exact attribution of either climate change to human activities, or attribution of climate change to security challenges facing the United States has not always been easy or clear. The almost linear relationship between fossil fuel emissions and global warming,¹⁹ despite past

difficulty in attributing causation, is now well established as a scientific consensus, as noted above. Anthropogenic climate change has been a politically charged issue nonetheless, primarily in the United States.

Prior to the 1990s, numerous US government reports and efforts documented the science of climate change and reflected the growing consensus.²⁰ After 2001, however, although US government reports explicitly tied *other* non-traditional threats to national security, federal mention of climate change was often minimized and even impeded until recent years.²¹

Interestingly, one example of a non-traditional threat has been the realm of public health, exemplified in the *National Security Strategy* (NSS) of 2006, which clearly ties naturally occurring infectious disease outbreaks to national security.²² Written during the Bush administration, the 2006 NSS emphasized the importance of addressing public health and pandemics such as HIV/AIDS and influenza as well as other natural disasters in a national security context. Among the other “challenges of globalization” the 2006 NSS addressed was “environmental destruction, whether caused by human behavior or cataclysmic mega-disasters such as floods, hurricanes, earthquakes, or tsunamis.”²³ This marked a significant enlargement in the scope of national security concerns, though despite discussion in the NSS of weather disasters such as 2005 Hurricanes Katrina and Rita, prominently left out of the 2006 NSS report was any mention of either the existence or the impact on security from threats arising out of global warming/climate change. Hence at the federal level, for a time, the tie between climate change and security, including the growing scientific linkages between extreme weather events and rising sea levels (and their causes) to US national security was downplayed or largely ignored.²⁴

Tying climate change to security requires at least two components to be causally related. First, human activities need to be tied to greenhouse gas production that in turn exacerbates the greenhouse effect and thereby warms the earth (and, as noted, this is now a given, as a scientific consensus), which subsequently causes a variety of ecological and social impacts. Second, that a

warming earth in turn causes security challenges vis-à-vis destruction of life, property, and the environment, and subsequent destabilization of human political, social, and economic systems.²⁵

IT'S EVEN WORSE THAN WE THOUGHT: RELATING HUMAN ACTIVITY TO GREENHOUSE GASES TO SECURITY

Since the early industrial age, increasing greenhouse gas concentrations (GHC) have been correlated to a rise in the Earth's average surface temperature. Given that most carbon dioxide released into nature from human activities comes from combusting fossil fuels, and that fossil fuels are the primary impetus for all modern economies, it's logical to conclude as consumption, production, manufacturing, and lifestyles have modernized, those activities are indeed driving climate change.

Population and development directly predict carbon emissions. Currently, ten nations contribute 80 percent of the total carbon emissions on earth and among these are the United States, China and Russia – trends expected to massively increase by 2030 given commonly projected increases in Earth's population.²⁶ As Earth's population has grown exponentially and as less developed nations modernize each year more completely, the rate of fossil fuel consumption worldwide has been increasing.²⁷ For instance, recent evidence suggests that climate models have been too conservative in their published projections regarding the severity of both global warming and the coming changes in climate and weather. This is evident given faster than predicted changes in sea level and glacial ice melting in Greenland and the Arctic.²⁸

Such published results about changes in Earth's climate have motivated even some of the few remaining climate expert skeptics to investigate their veracity. Such was the case with Berkeley researcher Richard Muller, who conducted a large-scale global warming assessment project headed by himself and funded in part by high profile climate change denying billionaires, the Koch brothers. Muller's study concluded that previous climate models and calculations were largely

correct in establishing that overall global average temperatures had risen almost 1 degree centigrade since the 1800s.²⁹

In addition to observed changes in the environment, social impacts of climate change have been increasingly monitored as well. Recent estimates are that global warming/climate change is responsible for 400,000 deaths per year and over \$1.2 trillion in damage – equivalent to 1.6 percent of global GDP. Although estimates vary, both resultant fatalities and economic damage are expected to increase over the next twenty to forty years.³⁰

Separately, air pollution from combusting fossil fuels is estimated to cause 4.5 million deaths per year.³¹ These connections have caused the topic, writ large, to be highly politicized and controversial. Controversy over the social causes and consequences of global environmental change aside, it is increasingly clear to the scientific and military communities that there are deep security concerns as well.

THE SCIENTIFIC COMMUNITY SUGGESTS TIES TO SECURITY

In 2012 and 2013 a number of US-based climate change reports highlighted both the scope and criticality of climate change. First, in late 2012, two important studies were published involving dozens of climate and security experts. Each study highlighted many of the same critical points about the growing social and security crisis attributable to climate change and related drivers. The first study was the Harvard University report entitled *Climate Extremes: Recent Trends with Implications for National Security*.³² The Harvard study was the product of a series of international climate change workshops among many top climate scientists, sponsored by the National Academy of Sciences, Columbia University, and the Harvard University Center for the Environment, and funded by the Central Intelligence Agency. Further, this study explored likely ten-year scenarios, and asked whether climate extremes seen up to then – including droughts, floods, severe storms, and heat waves – would persist, and if they were a result of natural variability or

greenhouse warming, and what the plausible impacts on US national security interests might be. The study concluded “that the early ramifications of climate extremes resulting from climate change are already upon us and will likely continue to be felt over the next decade – affecting human security and impacting US national security interests.” More specifically, regarding the United States, security implications included:

... more record high temperatures; fewer but stronger tropical cyclones; wider areas of drought and increases in precipitation; increased climate variability; Arctic warming and attendant impacts; and continued sea level rise as greenhouse warming continues and even accelerates. These changes will affect water and food availability, energy decisions, the design of critical infrastructure, use of the global commons such as the oceans and the Arctic region, and critical ecosystem resources. They will affect both underdeveloped and industrialized countries with large costs in terms of economic and human security. The study identifies specific regional climate impacts—droughts and desertification in Mexico, Southwest Asia, and the Eastern Mediterranean, and increased flooding in South Asia—that are of particular strategic importance to the United States.³³

Study author Michael McElroy added: “Lessons from the past are no longer of great value as a guide to the future... unexpected changes in regional weather are likely to define the new climate normal, and we are not prepared.”³⁴

A second key study was produced by the National Academies of Sciences (NAS) and National Research Council entitled *Climate and Social Stress: Implications for Security Analysis*. Commissioned by the US intelligence community, the report noted that:

The US intelligence and security communities have begun to examine a variety of plausible scenarios through which climate change might pose or alter security risks...to identify ways to increase the ability of the intelligence community to take climate change into account in assessing political and social stresses with implications for U.S. national security.³⁵

The NAS report places into a national security framework what climate change experts have been forecasting for some time: Specifically, climate-related events are often closely spaced in time, and can directly lead to cascading failures and crises in global food, water, trade, commodities, public health, economic, and political systems – particularly in countries and regions that are already fragile, poorly resilient, or stressed.³⁶

In 2013 the US National Climate Assessment (NCA), overseen by the sixty-person Federal Advisory Committee (the National Climate Assessment and Development Advisory Committee or NCADAC), is a group that was established in 2010 by the Department of Commerce and supported through the National Oceanic and Atmospheric Administration (NOAA). NCADAC laid out the likely implications to the US economy and to society attributable to climate change. The NCADAC, with contributions by more than 240 authors, projected a series of likely social impacts based on low, medium, and high greenhouse gas (GHG) emissions scenarios. Among the findings, NCADAC observed that climate change is not a uniformly distributed phenomenon and occurs faster in some places than others. For example, some top ice experts believe the Arctic region, where temperatures have risen much faster than the global average, could be almost ice-free in the summers over the next several years – and almost definitely so in the next twenty years.³⁷

Hence, purely as a result of persistent ice melt due to anthropogenic warming, the Arctic is fast becoming a national security concern. The geopolitical implications for free navigation of naval vessels through a soon-to-be open “Northern passage” are rapidly creating a need for additional Arctic and Law of the Seas-related treaty negotiations. Among other developments, Russia has placed military assets in the region to leverage control over the natural resources there (particularly seafood, fresh water, oil and gas), but also to stake a claim to mineral and territorial rights in this previously forbidding region.³⁸

In addition, a melting Arctic promises to have a significant impact on the average climate and weather in the Northern Hemisphere. As the NCA notes pointedly, the

United States, the largest *per-capita* global emitter of greenhouse gases, was going to experience among the greatest impacts of weather and climate disasters of any nation in the world given the idiosyncrasies of North American geography. Average temperatures in the United States have risen around 1.5 degrees F. since 1895 – with over 80 percent of that increase since 1980.³⁹ Hotter weather and drought will become much more common, and even the norm in the American Southwest, with average US temperatures likely to rise another 2 to 4 degrees F. over the next few decades, and from 4 to 10 degrees F. by 2100.⁴⁰

These estimates carry staggering implications and uncertainties which will affect health, agriculture, energy, transportation, water and food supply, and countless other critical infrastructure sectors. And, as the impact of 2012's "Superstorm" Sandy foreshadowed, rising sea levels will increasingly threaten coastal cities and communities with inundation, salt water intrusion into water supplies and farm land, and severe storm surge damage that radically change a region's economic outlook. Because of the quirks of geography and a warming-related slowdown of Gulf Stream ocean currents, the over 600 mile-long American Atlantic coast, a stretch reaching from North Carolina north to New York City and Boston, is experiencing some of the largest rises in sea levels.⁴¹ This observation is backed by other projections, and the US Geological Survey (USGS) reported that although global ocean level increased between 1950 and 2009 by an annual average of 0.02 inches, Atlantic coast levels north of Cape Hatteras, NC increased on average 0.08 inches a year.⁴²

Similarly in late 2012, the World Bank report, *Turn Down the Heat: Why a 4°C Warmer World Must be Avoided*, bleakly noted that the *most* likely scenario for 2100 would be over 7 degrees Fahrenheit (4 degrees C.) global average temperature increase. As the World Bank's report warns in what are now frequently repeated themes:

The 4°C scenarios are devastating: the inundation of coastal cities; increasing risks for food production potentially leading to higher malnutrition rates; many dry regions becoming dryer, wet regions wetter; unprecedented heat waves in many

regions, especially in the tropics; substantially exacerbated water scarcity in many regions; increased frequency of high-intensity tropical cyclones; and irreversible loss of biodiversity, including coral reef systems.⁴³

Increasingly, government research entities, scholars in health, science, economics, and military security are referencing climate change in terms of security.⁴⁴ These sources collectively warn of growing, interactive public health and economic damage, and the subsequent political upheaval that will result from growing world populations and looming resource shortages (especially oil and gas, food, and water). As the social, economic, and political concerns about global environmental change mount, it is becoming clearer that there are profound security concerns.

US NATIONAL SECURITY BUY-IN: PENTAGON AND INTELLIGENCE COMMUNITY ASSESSMENTS⁴⁵

In addition to the early military's greenhouse gas research noted above, all of the US national security institutions have acknowledged the scope and implications of climate change. Among them, the Pentagon has acknowledged the potential impacts of the combination of climate change and looming energy supply shortages as articulated in the 2010 *Quadrennial Defense Review* (QDR), the US Military's primary planning document published every four years.⁴⁶ For example, DoD is considering how best to reassess strategic priorities, and spur new efforts to find alternative energy technologies and improved efficiency in order to reduce military dependence on foreign oil/energy sources. It emphasized the likelihood for climate change to exacerbate

...poverty, environmental degradation, and the further weakening of fragile governments... and [t]he rising demand for resources, rapid urbanization of littoral regions, the effects of climate change, the emergence of new strains of disease, and profound cultural and demographic tensions in several regions are just some of the trends whose complex interplay may spark or exacerbate future conflicts.⁴⁷

Climate change will have a significant impact on its structure, missions, capabilities and operations in the future. For example:

Climate change and energy are two key issues that will play a significant role in shaping the future security environment. Although they produce distinct types of challenges, climate change, energy security, and economic stability are inextricably linked. The actions that the Department takes now can prepare us to respond effectively to these challenges in the near term and in the future. Climate change will affect DoD in two broad ways. First, climate change will shape the operating environment, roles, and missions that we undertake. The U.S. Global Change Research Program, composed of 13 federal agencies, reported in 2009 that climate-related changes are already being observed in every region of the world, including the United States and its coastal waters. Among these physical changes are increases in heavy downpours, rising temperature and sea level, rapidly retreating glaciers, thawing permafrost, lengthening growing seasons, lengthening ice-free seasons in the oceans and on lakes and rivers, earlier snowmelt, and alterations in river flows.

Second, DoD will need to adjust to the impacts of climate change on our facilities and military capabilities. The Department already provides environmental stewardship at hundreds of DoD installations throughout the United States and around the world, working diligently to meet resource efficiency and sustainability goals as set by relevant laws and executive orders. Although the United States has significant capacity to adapt to climate change, it will pose challenges for civil society and DoD alike, particularly in light of the nation's extensive coastal infrastructure. In 2008, the National Intelligence Council judged that more than 30 U.S. military installations were already facing elevated levels of risk from rising sea levels.⁴⁸

In a reaction to the QDR, former Senator John Warner (R-VA), spokesperson for the Pew Project on Energy, Security and Climate noted:

[The] Quadrennial Defense Review, which mirrors what leading military, intelligence, and security experts have told us about the impending threat of climate change and our

energy dependence, clearly exhibits that the Department is preparing for the worst of threats... Climate change has the potential to make natural disasters more frequent, adding more missions to the already heavy burdens of our military.⁴⁹

This is a compelling challenge, especially considering current austerity measures that now characterize the Department of Defense as well as other federal entities.

Affirming ties to US national security, the US intelligence community (IC) detailed potential implications to the intelligence community of global warming and climate change in its December 2012 report entitled *Global Trends 2030*. In the *Global Trends* report, the National Intelligence Council (NIC) emphasizes that climate change will create resource shortages, internal and international migration problems, and increased political conflict. Among projected "megatrends," the NIC forecasts increases in water, food, and energy demands (40, 35, and 50 percent, respectively, by 2030) due to global population increases and demands for improvements in standard of living (consumption patterns) among the growing global middle classes – even as climate change negatively impacts the supply of those resources. Specifically, the *Global Trends* report observed: "the decline in precipitation will occur in the Middle East and northern Africa as well as western Central Asia, southern Europe, southern Africa, and the U.S. Southwest."⁵⁰ The report also warns about the likelihood of "black swans" – unforeseen, dangerous crises and tipping points that are already emerging, and faster than previously expected which may cause large-scale regional destabilization. For example, "Rapid changes in precipitation patterns—such as monsoons in India and the rest of Asia—could sharply disrupt that region's ability to feed its population"⁵¹ by disruptions in water access, soil quality, and reduced capacity to produce food. Comparatively, Africa, Asia, and the Middle East will be most affected because of the combination of wide-spread poverty, lack of critical infrastructure, and a greater reliance on agriculture, and thus experience a resultant vulnerability to extreme weather, including heat disasters, drought, and catastrophic floods.⁵²

Confirming the international nature of the security concerns arising from global environmental change, the Center for American Progress concurs with the NIC assessment. In particular, that south Asia (India, Pakistan, Bangladesh, etc.) is expected to be more severely affected by climate change than most other areas.⁵³ This expectation is based on the large regional populations (and anticipated population growth) characteristic of the region, a relatively underdeveloped infrastructure, limited federal ability to respond to and recover from larger scale disasters, and the unique combination of geographic vulnerabilities, including rising sea levels, tropical cyclones from the Bay of Bengal and Arabian Sea, shrinking of critical river system water supplies that will come with receding Himalayan glacier water or disruption of seasonal monsoons, and catastrophic river and coastal flooding.⁵⁴ And as any student of geopolitics is aware, this region is already subject to radicalization and significant security tensions particularly between nuclear-armed enemies Pakistan and India. But water resource conflicts are also already starting to emerge between India, Bangladesh, and China to the north, over the Brahmaputra River, the headwaters of which are in the Himalayan Tibetan Plateau. The Brahmaputra flows through all three countries – which include the two most populous nations in the world – and all are under tremendous resource pressures to keep up with population growth and rising standards of living.⁵⁵ There are demands for increasingly scarce water supplies as well as hydroelectric power generation, and Chinese plans to divert upstream river flows for both are enflaming diplomatic relations.⁵⁶

Below are other recent reports and studies that reinforce the place of both the environment and climate as security and stability issues. Further, we observe that public health, strategic planning, intelligence, and military leaders are increasingly in general agreement with climate scientists and other environmental leaders:⁵⁷

- Britain's Ministry of Defense noted in a report "climate change will amplify existing social, political and resource stresses which can lead to the tipping

point at which conflict ignites."⁵⁸ In addition, the United Kingdom's Foreign Secretary, William Hague, was quoted saying that climate disruption is "perhaps the 21st century's biggest foreign policy challenge."⁵⁹

- The Washington DC-based International Institute for Strategic Studies (IISS) asserts, "Climate change will increase the risks of resource shortages, mass migration, and civil conflict. These could lead to failed states, which threaten global stability and security." IISS highlighted the need for "sustained investment in infrastructure and new technologies," and within such efforts "a shift to renewable energy sources will be the most visible effect of efforts to mitigate emissions." They conclude:

Although discussion is good, we can no longer delay implementing tough action that will make a difference, while quibbling over minor uncertainties in climate modeling. Unlike most recent natural disasters, this one is entirely predictable. Doctors, often seen as authoritative, trusted, and independent by their communities, must make their voices heard in calling for such action.⁶⁰

The evidence for human-caused warming and the already changing climate is overwhelming, even as precise details about what exactly will happen remain uncertain. This is true in part because the scope and speed of changes to the environment are mostly historically unprecedented (in either geological or human history). Scientists do not know precisely what may occur under various scenarios of stabilized carbon emissions vs. unchecked (and increasing) increases, which will need to incorporate cascading greenhouse gas emission feedback loops (as from melting tundra methane, lost Arctic ice, etc.), temperature increases, sea level rise, and other details. But they do know that their worst case fears are coming true, and they are getting better at modeling such predictions as historical and recent data streams in, validating the models.

From a policy perspective, environmental security is vexing. From a decision science perspective, ES is a *wicked problem*.⁶¹ That is, ES issues are interdisciplinary in nature, value-laden, exhibit complex interdependencies, are international in scope, and are dynamic and complex to solve. However, what is more clear is that in addition to human misery and suffering, economic disruption and cost, there have already been repercussions from climate change affecting political stability and the potential for political conflict. This is why it is essential to define ES in such a way as to facilitate its integration into national/homeland security strategic planning. In the next section, we address why and how environmental issues should be a key component of homeland security – and security at all levels.

THE SCOPE, DEFINITION, AND STRATEGIC CONTEXT OF ENVIRONMENTAL SECURITY (ES)

Many authors have written about the meaning, components of, or the varied definitions of homeland security.⁶² Extracted from the literature as a whole and bearing in mind they are not the only elements within HS, sub-dimensions of the larger homeland security enterprise are displayed in Table 1. Note that the larger construct of homeland security is effectively a composite of many complex dimensions. In this sense, homeland security can be considered a “meta-construct” or a complex, value-laden, dynamic construct that is in fact a composite of many *other* complex, value-laden, dynamic disciplines in much the same way as modern medicine, and the even broader public health system, are organized as complex composites of many sub disciplines and systems. It is inside of this context that we will define environmental security.

Law & Policy	Terrorism and Political Violence
Emergency Management	<i>Environmental Security</i>
Risk Analysis	Intelligence Studies
Critical Infrastructure Protection	Strategic Planning
Physical Security	Public Administration
Public Health	Communications
Organizational & Leadership Theory	Systems Engineering
Politics & International Relations	Economic Analysis
Science & Technology	Public Opinion & Social Psychology

Table 1. Suspected Dimensions (intellectual domains) of Homeland Security

The complete scope of the ES dimension of homeland security is hard to precisely define for primarily two reasons. First, the security consequences arising from the complex feedback loops of human influence on the natural environment are complex and change over time. Second, the social impacts arising from the characteristics, resource scarcities, and other aspects of the natural and made environments are not always clear. As we've seen above, the principles, causes and implications of global climate change are becoming increasingly important to a modern conceptualization of US and global security, challenging traditional definitions of domestic (homeland) security, national (military) security, and the broader but related notions of human, economic, and health security. In a general way, the totality of all these security concepts is integral to the overall scope of environmental security.

Following Hurricane Katrina and the resultant rise in gas prices, shortage of building materials, and the clear need in large disasters for federal assistance, Americans began to realize that natural disasters could be so traumatic, so expensive, and so disruptive that they could actually be considered threats to local, if not regional, stability and security.⁶³ In order to develop and justify in more detail the concept of *environmental security* as a critical sub-dimension of homeland and national security writ large, we will first discuss how ES might fit into various conceptions of "security" in a broader sense.

BROADER CONCEPTIONS OF SECURITY⁶⁴

Just as homeland security is a *contested concept*,⁶⁵ so is the more general term "security." In addition, both terms tend to be dynamic (fundamentally can change its meaning over time and in different contexts), complex (indicating there are several types and levels of security), and value-laden (meaning different things to different people). For example, security can be addressed in a wide spectrum of levels of analysis (ranging from individual to global security, to private security, to military security) and developed in a variety of policy

environments. In order to properly frame the importance of global climate and public health in a security paradigm, there are several pertinent frameworks of conceiving security that would help to contextualize ES. These include the concepts of human security (that of the individual, but in reference to no particular nation state), transnational security (beyond nation-states only), international security (involving multiple sovereign nation states), national security (traditionally involving the defense of a given nation), and homeland security (commonly conceptualized as relating to domestic issues).

Human security is an emerging paradigm for understanding global vulnerabilities. Proponents challenge the traditional notion of national security by arguing that the proper referent for security should be the individual rather than the state.⁶⁶ Human security holds that a people-centered view of security is necessary for national, regional, and global stability.

At the broadest, most complex end of the spectrum is global security, or *transnational security*, which includes the issues and challenges of *all* people, including governments and nation-states, but also non-governmental actors (individuals, groups, and organizations) within and transcending national borders.⁶⁷ Transnational security includes the highly complex, trans-border issues of global climate change and other environmental issues (e.g., global ozone depletion, fisheries loss, acid rain, etc.), as well as globalized economic integration (exemplified by the World Trade Organization, the European Union, etc.), global terrorism, organized crime, and a host of other similar issues.

International security as conceived by scholars and policy analysts has evolved since the end of the Cold War conflict between the Soviet and American superpowers, and the rise of globalized economic and political cooperation and integration to include many more issues and actors.⁶⁸ In the twenty-first century, traditional security notions now seem to include an expanded list of constituencies and actors including the military as well as political, economic, and even social actors. Such a development has

fundamentally changed the strategic thinking behind international security.

A related term, *national security*,⁶⁹ refers to the security of nation-states, or countries, as they are commonly known. In the United States during the Cold War, for instance, *traditional* national security definitions were oriented and aligned with military operations and objectives. However, over the ensuing twenty years, the concept widened over the breadth of issues that might be included within security definitions.⁷⁰ At a policy level, US national security is funded by both House and Senate financial appropriations and historically relates to a military defense of national interests from traditionally military entities implemented and determined primarily at the level of the *executive branch* of government.

Environmental Security (ES) challenges certain traditional notions of *national security* and *homeland security* because of the complex nature of the issues it incorporates as described above. By necessity ES must include many *non-traditional security* stakeholders, even at the national level alone – including US agencies such as the Environment Protection Agency (EPA), the National Aeronautics and Space Administration (NASA), the Department of Agriculture, the National Oceanic and Atmospheric Administration, the Department of Energy, and the Public Health Service, as well as many independent and government scientists doing research on climate change-related issues, technologies, etc.⁷¹ For example, some states, such as California, have independently enacted climate security related legislation to reduce greenhouse gas (GHG) emissions through regulation and tax incentives.⁷²

To define ES requires an appreciation of the intersection of human security and human activity and wellbeing as they interact with the global environment, including the causes and effects of environmental degradation. Hence, ES would integrate climate science, critical infrastructure protection, emergency management, public health and the resulting impact on the political economies, governments, and societies around the world. In her dissertation research, Elizabeth Chalecki suggests ES is “the ability of a nation or a

society to withstand environmental asset scarcity, environmental risks or adverse changes, or environment-related tensions or conflicts.”⁷³ Though somewhat dated now, the Millennium Project surveyed many of the competing global versions of ES in a late 1990s,⁷⁴ looking at various ways the term was used by experts, national governments, and international organizations.

A WORKING DEFINITION OF ENVIRONMENTAL SECURITY

There is no gold standard definition of ES, just as there is none for HS, but we believe good social scientific analysis of such a contested concept, as a sub-category of other theoretical constructs, should offer a working definition – rather than assume a term's meaning is well-known or well-established. We would offer the following definition of ES, from an academic or practice analytical perspective: *Environmental security is a process for understanding how extreme environmental or climatic events, acting locally or trans-nationally, can destabilize countries or regions of the world, resulting in geopolitical instability, resource conflicts, and subsequently enhanced risk to critical infrastructure, or a combination of these.*

Considering this definition, environmental security is, in many regards, the ultimate *transnational security* problem since it addresses security challenges that are the result of a complex mixture of physical, economic and political eco-systems issues, as well as the dynamic and often unpredictable interplay between natural and human systems. As a result, ES is often not just a localized domestic security problem for one nation. Rather, ES more often involves complex global security policy issues, requiring the participation of several governments, industrial organizations and non-governmental organizations, as well as many other global, regional and local groups.

INCORPORATING ENVIRONMENTAL SECURITY INTO THE STRATEGIC CONTEXT OF HOMELAND SECURITY

How might ES fit in within a larger strategic context of national or homeland security?

Broadly, as defined above, environmental security concerns the domestic security of civilians within the United States or any other country, and this includes at a minimum emergency management activities that the Federal Emergency Management Agency (FEMA), a part of the Department of Homeland Security, might perform in the United States. Thus, in addition to political violence/terrorism, ES includes threats to the US economy from large-scale environmental accidents (such as the BP Deepwater Horizon Gulf oil spill); geological events (i.e., tsunamis, earthquakes)⁷⁵ and climatic or weather extremes (such as Hurricane

Katrina, and even the 2011-12 US Western states' drought, aptly illustrated); strategic resource shortages (food, water, energy, etc.); and/or deficits to critical infrastructure (CI) – the mechanisms by which societies operate. In this sense, ES straddles the realms of transnational/trans-border, traditional international, national, as well as human security problem sets. And because it addresses both the risks of natural disasters and even of precursors to political disruption that can lead to terrorism, environmental security should be considered a key element of “homeland” security as well.

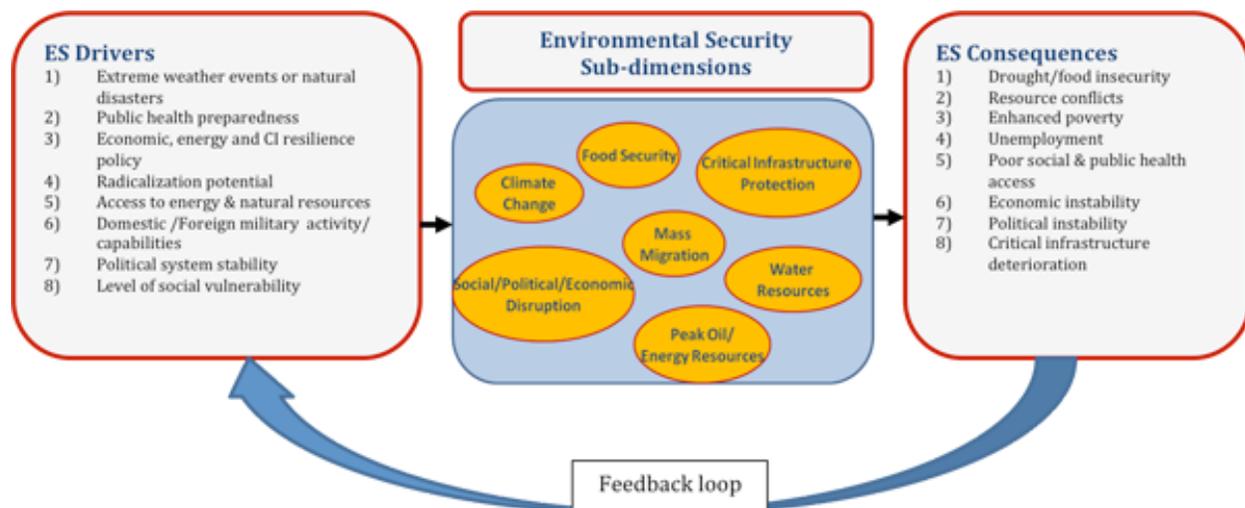


Figure 1. General Structure of the Environmental Security Construct, Drivers & Consequences

ENVIRONMENTAL SECURITY IN BOTH MDCS AND LDCS

While not intended to be exhaustive, Figure 1 represents the general structure of the ES construct along with many of its proposed dimensions, drivers, consequences, feedback loops and inherent relationships integral to the ES construct and pertinent to strategic security planning. It is important to recall the proposed definition of ES when considering

Figure 1 in that ES is suspected of acting differentially across More Developed Countries (MDCs) such as the U.S. versus Less Developed Countries (LDCs) such as Mali. As such, it is worthy to note that even the wealthiest nations of the world, the United States, Scandinavia, Germany, Switzerland, Japan, etc., are vulnerable to major environmental disasters stemming from extreme weather events. Given the interdependencies of energy, water, and food

security, and the economic impacts from large-scale natural disasters, global climate change in particular imparts an important range of security and policy challenges. Such impacts present challenges for the broader civilian domestic security construct (aka “homeland security”), as well as for practitioners and academic theorists alike.

Extreme weather events or the consequences of climate change result in direct threats to any population’s wellbeing, jeopardizing the health and physical security of that population. In this sense, environmental threats act as instability multipliers in all nations, but especially in fragile nations or regions characterized by pervasive conflict. As a result, climate-related crises exacerbate existing societal challenges such as political instability, poverty, health, and migration, ultimately acting as catalyst for political unrest and reduced government legitimacy in the eyes of a nation’s populace. Therefore avoiding or offsetting catastrophic environmental changes could result in less economic destabilization, less poverty and less disruptive migration, fewer refugees, and subsequently less regional destabilization.

For example, one recent potential environmental security hypothesis involves the “Arab Spring.” It is probable that environmental variables played a significant role in at least some of the triggering events of the now-famous series of political upheavals in the Middle East. It is widely believed, for instance, that sharp spikes in food prices contributed to the “Arab Spring” uprising in the Middle East in 2010-2011, in part. The first manifestation of political turmoil occurred in Tunisia, and began with food protests due to rising food prices. Eventually this led to the fall of the Mubarak government in Egypt.⁷⁶ The presumed linkage between climate-linked drought and subsequent crop failures in Russia in 2010 led to global food price increases – and political instability and food protests in poorer countries such as Egypt. This instability then undermined that government’s political legitimacy, and arguably sparked the protests that resulted in Hosni Mubarak’s downfall. Indeed, the continuing drought-related crop failures in the United States in 2012 and those projected by the continuing 2013 drought had already

driven up global food prices as of this writing.⁷⁷ This may present another real-life case to further test the ES hypothesis regarding food-related political instability that might influence HS.

CONCLUSIONS

Ultimately, environmental security teaches us that just as homeland security doesn’t end at the border; neither does national security start at the border. However, changes in traditional modes of thought and culture are never easy to accomplish as John Maynard Keynes reminds us:

The idea of the future being different from the present is so repugnant to our conventional modes of thought and behavior that we, most of us, offer a great resistance to acting on it in practice.⁷⁸

However, as documented above, there is mounting evidence that the principles and lessons ES offers are much more acceptable now to traditional national security analysts and institutions than has ever been the case. As the National Intelligence Council recently observed:

We are at a critical juncture in human history, which could lead to widely contrasting futures. It is our contention that the future is not set in stone, but is malleable, the result of an interplay among megatrends, game-changers and, above all, human agency. Our effort is to encourage decision-makers—whether in government or outside—to think and plan for the long term so that negative futures do not occur and positive ones have a better chance of unfolding.⁷⁹

Further, the October 2012 Harvard report on climate extremes outlines the US domestic “homeland” and national security interests in combatting climate change – both from prevention and adaptation and response dimensions. The report warns that the risks associated with extreme weather necessitate sustained and supplemented critical infrastructure, and a national strategy to improve scientific and technical situational awareness – particularly in the ability to track key variables (greenhouse gases; atmospheric, land and ocean temperatures; Arctic, Greenland, permafrost, and Antarctic

ice melt; species decline and extinction; ocean acidification and coral reefs; and decline and collapse of entire ecosystems; etc.) and events that might enable better advanced warning about international security threats arising from changing climate. “Our critical observational infrastructure is at risk from declining funding... Without that knowledge, the needs of civil society and national security for mitigation and adaptation will go unmet.”⁸⁰

Environmental security has become a component of homeland security and overall national security interests for all nations, developed and not, if for no other reason than environmental and vital resource access issues can be tied directly to emergence of broader political disruption, violence and ultimately even terrorism, as well as rapidly growing threats to critical infrastructure protection. In this way, ES challenges traditional notions of national security because military prowess may not be the best instrument of national power to address – and particularly to prevent – the complex global environmental and resource threats ES poses. Further, ES broadens and enriches an emergent (though currently unresolved) definition and mission portfolio for homeland security, in the face of domestic challenges that require new models of comparative risk analysis, budgeting, interdisciplinary policy, and interagency collaboration.

Clearly the attention and focus on the policy consequences of global warming, and the scientific consensus on the basic fact of anthropogenic climate changes, goes well beyond the academic science communities. A systematic, rigorous study of environmental security in the context of homeland security will require embracing a diverse collection of disciplines and practitioners to address the unique, important (and complex) resource scarcity and climate change problem sets. While some of this progress will be made quickly, other aspects will take more time. Regardless, resilient, sustainable solutions are needed now.

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¹ Remarks of International Monetary Fund Managing Director Christine Lagarde, speaking at the World Economic Forum in Davos, Switzerland, January 2013, as reported by David Runnalls, "Roasted, Toasted, Fried and Grilled: Climate-change Talk from an Unlikely Source," *Global and Mail*, February 1, 2013, <http://www.theglobeandmail.com/commentary/roasted-toasted-fried-and-grilled-climate-change-talk-from-an-unlikely-source/article8077946/>. Lagarde is a former finance minister in the conservative French government of Nicolas Sarkozy. She was answering audience questions about critical issues for the world's economic future.

² "Drought on Verge of Reaching Dust Bowl Proportions as Severe Dry Weather is Forecast to Get Worse... and it Forces up the Price of Groceries," *Daily Mail*, July 16, 2012, <http://www.dailymail.co.uk/news/article-2174446/Drought-verge-Dust-Bowl-proportions-severe-dry-weather-forces-price-groceries.html?ito=feeds-newsxml>; Kenneth Strzpek, Gary Yohe, James Neumann and Brent Boehlert, "Characterizing Changes in Drought Risk for the United States from Climate Change," *Environmental Research Letters* 5 (October-December 2010), iopscience.iop.org/1748-9326/5/4/044012/fulltext/.

³ Matt Pearce, "Western Wildfires Destroy Nearly 1,000 Homes so Far this Year," *Los Angeles Times*, July 1, 2012, <http://www.latimes.com/news/nation/nationnow/la-na-nn-recordbreaking-wildfires-20120701,0,2490361.story>

⁴ Jason Samenow, "Derecho: Behind Washington, D.C.'s Destructive Thunderstorm Outbreak, June 29, 2012" *Washington Post*, June 30, 2012, http://www.washingtonpost.com/blogs/capital-weather-gang/post/derecho-behind-washington-dcs-destructive-thunderstorm-outbreak-june-29-2012/2012/06/30/gJQA22O7DW_blog.html.

⁵ Zack Colman, "Napolitano on Weird Weather and Climate Change: 'There's a Pattern Here'," *The Hill*, July 5, 2012, <http://thehill.com/blogs/e2-wire/e2-wire/236357-napolitano-on-weird-weather-and-climate-change-theres-a-pattern-here>

⁶ For a discussion of surveys of experts and the many scientific academies and organizations that endorse the scientific consensus – or do not oppose it, see Skeptical Science, "Is there a global consensus on global warming?" <http://www.skepticalscience.com/global-warming-scientific-consensus-intermediate.htm>. As noted in this discussion: "A survey of all peer-reviewed abstracts on the subject 'global climate change' published between 1993 and 2003 shows that not a single paper rejected the consensus position that global warming is man caused (Oreskes, N. Science 3 December 2004: Vol. 306 no. 5702 p. 1686). 75% of the papers agreed with the consensus position while 25% made no comment either way (focused on methods or paleoclimate analysis)."

⁷ Many people are unaware that simply measuring atmospheric heat build up is wholly inadequate for assessing the scope of the problem. According to the Intergovernmental Panel on Climate Change (IPCC), between 1993 and 2003 alone, the oceans absorbed more than 90 percent of the additional trapped heat. This is good for the short-term atmospheric implications, but very bad for the long-term overall climate change – since that stored energy will change global climate and ocean dynamics eventually. For a good graph of the IPCC data, see <http://www.skepticalscience.com/graphics.php?g=12>;

⁸ Both global warming and climate change beget each other in the end – as warming causes climate changes that lead to feedback loops that further exacerbate warming. For a discussion of the difference between climate change and global warming, see for instance W Shi, S Wang, Q Yang, "Climate Change and Global Warming," *Reviews in Environmental Science and Bio/Technology* 9 (May 7, 2010):99-102; and for an very good timeline of climate change science progress over the last 150 years, see John Mason, "The History of Climate Science," Skeptical Science (April 7, 2013) at <http://www.skepticalscience.com/history-climate-science.html>

⁹ Previously cautious about tying extreme weather to climate, scientists are much more confident about the connection – particularly in heat/drought events. See, for instance, John Carey, "Storm Warnings: Extreme Weather is a Product of Climate Change," *Scientific American* (June 28, 2011), <http://www.scientificamerican.com/article.cfm?id=extreme-weather-caused-by-climate-change>; Jason Samenow, "NOAA Scientist: 80 Percent Chance Recent Heat Records Due to Climate change," *Washington Post*, July 10, 2012, http://www.washingtonpost.com/blogs/capital-weather-gang/post/noaa-scientist-80-percent-chance-todays-heat-records-due-to-climate-change/2012/07/10/gJQAdv9waW_blog.html; and Deborah Zabarenko and Laura Zuckerman, "West's Wildfires a Preview of Changed Climate: Scientists," *NewsDaily*, June 28, 2012, <http://www.newsdaily.com/stories/bre85r1pk-us-usa-wildfires-climate/#>

¹⁰ This was in contrast to all of his predecessors, though Tillerson downplayed the impact. "Climate Change Fears Overblown, says ExxonMobil Boss," *The Guardian*, June 28, 2012, <http://www.guardian.co.uk/environment/2012/jun/28/exxonmobil-climate-change-rex-tillerson>

¹¹ Colman, "Napolitano on Weird Weather."

¹² The seminal article at the time, demonstrating that human carbon emissions were not just being absorbed by the oceans, was Roger Revelle and Hans E. Suess, "Carbon Dioxide Exchange between Atmosphere and Ocean and the Question of an Increase of Atmospheric CO₂ During the Past Decades," *Tellus* 9 (1957):18-27.

¹³ Richard B. Alley, *Earth: An Operator's Manual* (New York: W. W. Norton & Company, 2011).

¹⁴ The lighter carbon-12 from fossil fuels burning is contrasted with heavier, natural carbon-13. See John Cook, "The Scientific Guide to Global Warming Skepticism," SkepticalScience.com, December 2010, http://www.physics.smu.edu/pseudo/GlobalWarming/Guide_to_Skepticism.pdf and A.C. Manning and R.F. Keeling, R.F. (2006). Global oceanic and land biotic carbon sinks from the Scripps atmospheric oxygen flask sampling network," *Tellus Series B-Chemical and Physical Meteorology*, 58 (2006): 95–116.

¹⁵ Indeed, absent major changes in current trajectory, climate change is arguably set to become one of the largest ongoing disasters in all of human history.

¹⁶ A. Leiserowitz, E. Maibach, C. Roser-Renouf, and N. Smith, *Global Warming's Six Americas* (Yale Project on Climate Change Communication, 2011) and Z. Leviston, A. Leitch, M. Greenhill, R. Leonard, and I. Walker, *Australians' Views of Climate Change* (Commonwealth Scientific and Industrial Research Organisation, 2011).

¹⁷ At least until recently the Europeans were the main drivers of global climate treaty agreements, though the long-term economic recessionary weakness in the EU after 2008 slowly reduced political willingness among many EU countries to make major cuts in carbon outputs. See for instance Barbara Lewis, "Euro debt crisis saps EU's ability to lead climate debate," *Reuters*, November 26, 2012, <http://www.reuters.com/article/2012/11/26/us-climate-talks-eu-idUSBRE8AP08H20121126>

¹⁸ Peter T. Doran and Maggie Kendall Zimmerman, "Examining the Scientific Consensus on Climate Change," *EOS*, Transactions American Geophysical Union 90, no. 3 (January 2009), http://tigger.uic.edu/~pdoran/012009_Doran_final.pdf.

¹⁹ Concordia University, "Carbon Emissions Linked To Global Warming In Simple Linear Relationship," *ScienceDaily*, June 11, 2009, <http://www.sciencedaily.com/releases/2009/06/090610154453.htm>

²⁰ Naomi Oreskes, "The Long Consensus on Climate Change," *Los Angeles Times*, February 1, 2007, <http://www.washingtonpost.com/wp-dyn/content/article/2007/01/31/AR2007013101808.html>.

²¹ Jim Tankersley and Alexander C. Hart, "Bush-era EPA Document on Climate Change Released," *Los Angeles Times*, October 1, 2009, <http://articles.latimes.com/2009/oct/14/nation/na-epa-climate14>.; Mark Townsend and Paul Harris, "Now the Pentagon Tells Us: Climate Change will Destroy Us," *The Guardian UK*, February 21, 2004, <http://www.guardian.co.uk/environment/2004/feb/22/usnews.theobserver>

²² The White House, *United States National Security Strategy of 2006* (Washington, DC: Government Printing Office, March 2006), <http://merln.ndu.edu/whitepapers/USnss2006.pdf>

²³ *Ibid.*, 52.

²⁴ It is beyond the scope of this discussion to adequately describe the convoluted American climate change politics, but the literature is extensive. Among the best histories is Naomi Oreskes and Erik Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (Bloomsbury Press, 2010). For a number of other links to discussions of climate science denial during the Bush administration, including Congressional testimony by Rick Piltz, a former senior scientist under the Bush administration, who documented efforts to suppress climate science reports before and after he resigned, see Rick Piltz, "New National Climate Assessment draft report a reminder of the first NCA and the Bush White House denial machine." Climate Science Watch, January 28, 2013, <http://www.climate-science-watch.org/2013/01/28/new-national-climate-assessment-draft-report-a-reminder-of-the-first-nca-and-the-bush-white-house-denial-machine/>

²⁵ For instance, as NASA's Erik Conway points out, "temperature change itself isn't the most severe effect of changing climate. Changes to precipitation patterns and sea level are likely to have much greater human impact than the higher temperatures alone. For this reason, scientific research on climate change encompasses far more than surface temperature change. So 'global climate change' is the more scientifically accurate term. Like the Intergovernmental Panel on Climate Change, we've chosen to emphasize global climate change on this website, and not global warming. See Erik Conway, "What's In a Name? Global Warming vs. Climate Change," NASA, December 9, 2008, http://www.nasa.gov/topics/earth/features/climate_by_any_other_name.html

²⁶ National Public Radio, "Climate Change Trends: Carbon Emission Giants", December 10, 2011, <http://www.npr.org/2009/12/11/121240453/climate-change-trends-carbon-emissions-giants>

²⁷ International Energy Agency, *Key World Energy Statistics 2011* (IEA, 2012), http://www.iea.org/publications/freepublications/publication/name_20938_en.html and Worldwatch Institute, "Global Fossil Fuel Consumption Surges," Worldwatch Institute (2005), <http://www.worldwatch.org/global-fossil-fuel-consumption-surges>

²⁸ Glenn Scherer and DailyClimate.org, "Climate Science Predictions Prove Too Conservative: Checking 20 years worth of projections shows that the Intergovernmental Panel on Climate Change has consistently underestimated the pace and impacts of global warming," *Scientific American*, December 6, 2012, <http://www.scientificamerican.com/article.cfm?id=climate-science-predictions-prove-too-conservative>; and S. Rahmstorf, G. Foster, and A. Cazenave, "Comparing climate projections to observations up to 2011," *Environmental Research Letters* 7 (2012), <http://iopscience.iop.org/1748-9326/7/4/044035/article>

²⁹ Yale Global Online, "Climate Skeptic Reverses Course," August 1, 2012, <http://yaleglobal.yale.edu/content/koch-funded-climate-change-skeptic-reverses-course>.

³⁰ "Climate Change is already damaging the Global Economy, report finds," *The Guardian*, September 26, 2012, <http://www.guardian.co.uk/environment/2012/sep/26/climate-change-damaging-global-economy>

³¹ Ibid.

³² Michael McElroy and D. James Baker, "Climate Extremes: Recent Trends with Implications for National Security." Harvard University Center for the Environment (October 2012)

³³ Ibid., 69.

³⁴ Michael McElroy quoted in "A New Harvard Report Probes Security Risks of Extreme Weather and Climate Change," Harvard University Center for the Environment press release, October 2012, <http://environment.harvard.edu/climate-extremes>

³⁵ John D. Steinbruner, Paul C. Stern, and Jo L. Husbands, Editors, *Climate and Social Stress: Implications for Security Analysis* (National Academies of Science, Committee on Assessing the Impact of Climate Change on Social and Political Stresses; Board on Environmental Change and Society; Division of Behavioral and Social Sciences and Education; National Research Council, 2012).

³⁶ Ibid, 3.

³⁷ Decline in arctic ice keeps breaking records and exceeding the models. John Vidal, "Arctic expert predicts final collapse of sea ice within four years," *The Guardian* UK, September 17, 2012, <http://www.guardian.co.uk/environment/2012/sep/17/arctic-collapse-sea-ice> and National Climate Assessment and Development Advisory Committee, *National Climate Assessment Draft Report* (Washington, DC: NOAA, 2013), 29. This is written by a federal advisory committee established as per the Federal Advisory Committee Act of 1972. The Committee serves to oversee the activities of the National Climate Assessment. Its members are diverse in background, expertise, geography and sector of employment. A formal record of the committee can be found at the NOAA NCADAC website. See <http://ncadac.globalchange.gov/>

³⁸ Elisabeth Rosenthal, "Race Is On as Ice Melt Reveals Arctic Treasures," *New York Times*, September 18, 2012, http://www.nytimes.com/2012/09/19/science/earth/arctic-resources-exposed-by-warming-set-off-competition.html?pagewanted=all&_r=0; and National Climate Assessment Draft Report, *ibid.* (various sections)

³⁹ Ibid.

⁴⁰ Ibid.

⁴¹ Wynne Parry, "Northeastern U.S. Coast is 'Hotspot' for Sea Level Rise," LiveScience, June 25, 2012, <http://www.livescience.com/21158-sea-level-rise-northeast-coast.html>. See also, Michael D. Lemonick, "Sea Level Rising Faster Than Average In Northeastern U.S." Climate Central, October 18, 2012, <http://www.climatecentral.org/news/sea-level-rising-faster-than-average-in-the-u.s.-northeast-15129>; Asbury H, Sallenger Jr., Kara S. Doran, and Peter A. Howd, "Hotspot of accelerated sea-level rise on the Atlantic coast of North America." *Nature Climate Change* 2 (2012), <http://www.nature.com/nclimate/journal/v2/n12/full/nclimate1597.html>. As scientists note, the rise in East Coast sea levels is due to a number of factors, including post-ice age land subsidence in some areas such as Norfolk, VA. But clearly some is due to warming-related disruptions in ocean currents, heat-expanded water volume, and melting of worldwide glacial ice.

⁴² Ibid.

⁴³ World Bank, *Turn Down the Heat: Why a 4°C Warmer World Must be Avoided* (World Bank Report, Potsdam Institute for Climate Impact Research and Climate Analytics, November 2012), ix.

⁴⁴C. Dale, *National Security Strategy: Legislative Mandates, Execution to Date, and Considerations for Congress* (Congressional Research Service, May 28, 2008); TR News, "Security and Critical Infrastructure Protection: Progress and Paths to Resilience," *Transportation Research Board of the National Academies of Science* 275 (July-August, 2011); J. Busby, T. Smith, K. White, S. Strange, *Locating Climate Insecurity: Where are the Most Vulnerable Places in Africa?* (The Robert Strauss Center for International Security and Law, August 2010); B. Vaughn, N. Carter, P. Sheikh, R. Johnson, *Security and the Environment in Pakistan* CRS report 7-57-- (Congressional Research Service, August 3, 2010); National Academies, *National Security Implications for Climate Change for US Naval Forces: Letter Report* (Committee on National Security Implications of Climate Change for US Naval Forces, 2010); J. Ackerman. "Climate Change, National Security, and the QDR: Avoiding the Perfect Storm," *Strategic Studies Quarterly* (Spring 2008); C. Parthemore and W. Rogers, *Sustaining Security: How Natural Resources Influence National Security* (Center for New American Security, June 2010); J. Busby, *Climate Change and National Security: An Agenda for Change*, CSR no. 32 (Council on Foreign Relations, November 2007); *2009 US National Intelligence Strategy*.

⁴⁵ Interestingly, in addition to the security, intelligence and defense industries, several other US federal agencies now monitor climate change science. Included are: the Centers for Disease Control and Prevention at <http://www.cdc.gov/climateandhealth/publications.htm>, the Environmental Protection Agency at <http://www.epa.gov/climatechange/> and the U.S. Department of Agriculture at: http://www.usda.gov/oce/climate_change/.

⁴⁶ US Department of Defense, *The Quadrennial Defense Review*, May 2011, <http://www.defense.gov/qdr/>.

⁴⁷ Ibid., 7.

⁴⁸ Ibid., 84-85.

⁴⁹ The Pew Project on Energy, Security and Climate, "Pew Project on National Security, Energy and Climate Reacts to Department of Defense's Quadrennial Defense Review," Press Release, February 3, 2010, http://www.pewtrusts.org/news_room_detail.aspx?id=57140.

⁵⁰ National Intelligence Council, *Global Trends 2030: Alternative Worlds* (NIC, December 2012), iv, www.dni.gov/nic/globaltrends.

⁵¹ Ibid., 16.

⁵² Ibid., 44.

⁵³ Arpita Bhattacharyya and Michael Werz. "Climate Change, Migration, and Conflict in Southern Asia: Rising Tensions and Policy Options across the Subcontinent," *Center for American Progress Report* (December 2012), 1.

⁵⁴ Ibid.

⁵⁵ Ibid.

⁵⁶ Robert G. Wirsing, "The Brahmaputra: Water hotspot in Himalayan Asia." Global Water Forum, June 2, 2012, <http://www.globalwaterforum.org/2012/06/02/the-brahmaputra-water-hotspot-in-himalayan-asia/>

⁵⁷ "Climate Change Threatens Global Security, Warn Medical and Military Leaders," from the *British Medical Journal* as cited at ScienceDaily, April 5, 2011, <http://www.sciencedaily.com/releases/2011/04/110405194110.htm>.

⁵⁸ Ibid.

⁵⁹ Ibid.

⁶⁰ Ibid.

⁶¹ Wicked problems are problems that exhibit the following characteristics: the solution depends on how the problem is framed, stakeholders vary considerably in how they define and understand the problem, the constraints and resources available to address the problem change over time, the problem is never (totally) solved. See Tom Ritchey, *Wicked Problems* (Swedish Morphological Society, 2005, revised 2013), <http://www.swemorph.com/pdf/wp.pdf>

⁶² See *Homeland Security Affairs* VI, no. 2 (May 2010) dedicated to homeland security program development. Specifically, James Ramsay, Daniel Cutrer and Robert Raffel “Development of an Outcomes-based, Undergraduate Curriculum in Homeland Security”, <http://www.hsaj.org/?article=6.2.4>; Greg Moore, John Hatzodony, Kelly Cronin, Mary Brekenridge. “Homeland Security-Related Education and the Private Liberal Arts College,” <http://www.hsaj.org/?article=6.2.1>; and Cheryl Polson, John Persyn, Shawn. Cupp, “Partnership in Progress: “A Model for Development of a Homeland Security Graduate Degree Program,” <http://www.hsaj.org/?article=6.2.3>. See also Christopher Bellavita, “Changing Homeland Security: What is Homeland Security?” *Homeland Security Affairs* IV, no. 2 (June 2008), <http://www.hsaj.org/?article=4.2.1#>.

⁶³ For a case study on Hurricane Katrina, (as well as Arctic Security) see the James Ramsay and Linda Kiltz, *Critical Issues Within the Homeland Security Enterprise: A Casebook* (Boulder, CO: Westfield Press, Praeger Publications, forthcoming Summer 2013), ISBN 978-0-8133-4827-8.

⁶⁴ This section is adapted from Terrence M. O’Sullivan and James Ramsay, “Environmental Security and Public Health,” in Keith Logan and James Ramsay, eds., *Introduction to Homeland Security* (Westview Press, 2012).

⁶⁵ Contested refers to the general consensus at the moment of the lack of uniform definition or understanding of the term “homeland security”. See specifically Bellavita “What is Homeland Security” and the more recent publication by Shawn Reese, *Defining Homeland Security: Analysis and Congressional Considerations* (Congressional Research Service, January 8, 2013).

⁶⁶ United Nations Human Security Unit, *Human Security in Theory and Practice* (United Nations Trust Fund for Human Security, 2009), http://hdr.undp.org/en/media/HS_Handbook_2009.pdf.

⁶⁷ See for example, David P. Fidler, “Transnational Threats to National Security: Daniel Deudney’s Case Against Linking Environmental Degradation and National Security,” <http://www.princeton.edu/~ppns/papers/Fidler.pdf>.

⁶⁸ “International security” is also a contested concept, and the most orthodox (Cold War-era especially) definitions addressed primarily military issues. But many scholars and analysts now advocate far broader definitions that include other, non-military, threats to the security of nations. For a discussion of this evolving thinking, see Barry Buzan and Lene Hansen, *The Evolution of International Security Studies* (Cambridge, MA: Cambridge University Press, 2009); and Barry Buzen, Ole Wæver, and Jaap DeWilde, *Security: A New Framework for Analysis* (Boulder, CO: Lynne Rienner Publishers, 1998). Further, Harold Brown went on to include both economic and environmental security as dimensions of US national security. Harold Brown, *Thinking about National Security: Defense and Foreign Policy in a Dangerous World* (1983) as quoted in Cynthia Ann Watson, Cynthia Ann (2008). *U.S. National Security: a Reference Handbook*, 2nd (revised) ed. (ABC-CLIO, 2008), 281. ISBN 978-1-59884-041-4. <http://books.google.co.in/books?id=KnIR4YO2vsC>.

⁶⁹ Interestingly, the term “national security” is not uniformly defined. Indeed a review of policies and acts related to the design and production of US national security varies depending on the context. For example, Maier’s definition is: “National security... is best described as a capacity to control those domestic and foreign conditions that the public opinion of a given community believes necessary to enjoy its own self-determination or autonomy, prosperity and wellbeing.” Charles S. Maier, “Peace and security for the 1990s,” unpublished paper for the MacArthur Fellowship Program, Social Science Research Council, June 12, 1990. Quoted in “Defining National Security” by Joseph J. Romm, 1993, Council on Foreign Relations Press (New York) p5. ISBN 0876091354.

⁷⁰ Buzen, Wæver, and DeWilde, *Security: A New Framework for Analysis*.

⁷¹ See for example: the Centers for Disease Control and Prevention at <http://www.cdc.gov/climateandhealth/publications.htm>; the Environmental Protection Agency at <http://www.epa.gov/climatechange/>; and the U.S. Department of Agriculture at http://www.usda.gov/oc/climate_change/.

⁷² See for example: <http://www.arb.ca.gov/cc/ab32/ab32.htm>.

⁷³ See for instance Elizabeth Chalecki, “Environmental Security: A Case Study of Climate Change” (Pacific Institute for Studies of Development, Environment, and Security, 2002), http://www.pacinst.org/reports/environment_and_security/.

⁷⁴ The Millennium Project synthesis found commonalities in the ES definitions surveys with the core ability of the environment to support life, and with three sub-elements, including the dynamic of military damage to the environment, prevention or response to environmentally caused conflicts, and justification of environmental protection on intrinsic moral grounds. Millennium Project: Environmental Security Definitions can be found at <http://www.millennium-project.org/millennium/es-2def.html>.

⁷⁵ Japan's earthquake and tsunami was estimated to have cost well over \$200 billion, *not* including the as-yet undetermined costs of the Fukushima Daishi nuclear plant disaster. Geir Moulson, "Japan Tsunami Pushes 2011 into Record for Insurance Losses," *Associated Press*, January 8, 2012, http://www.tulsaworld.com/business/article.aspx?subjectid=51&articleid=20120108_51_E2_CUTLIN520922. Read more from this *Tulsa World* article at http://www.tulsaworld.com/business/article.aspx?subjectid=51&articleid=20120108_51_E2_CUTLIN520922

⁷⁶ See, for instance, Steve Baragona, "2011 Food Price Spikes Helped Trigger Arab Spring, Researchers Say," *Voice of America*, December 13, 2011, <http://www.voanews.com/content/article-2011-food-price-spikes-helped-trigger-arab-spring-135576278/149523.html>; and Clemens Breisinger, Olivier Ecker and Perrihan Al-Riffai, *Economics of the Arab Awakening* (Washington, DC: International Food Policy Research Institute, 2011), <http://www.ifpri.org/publication/economics-arab-awakening>

⁷⁷ Ira Lager, "Why are Food Prices Rising? Check the Weather." *Bloomberg Business Week*, January 10, 2013, <http://www.businessweek.com/articles/2013-01-10/why-are-food-prices-rising-check-the-weather>; and Liam Halligan, "Rising Food Prices Will Reap a Bitter Harvest," *The Telegraph*, January 6, 2013, <http://www.telegraph.co.uk/finance/comment/liamhalligan/9782815/Rising-food-prices-will-reap-a-bitter-harvest.html>

⁷⁸ Keynes, quoted in the National Intelligence Council, *Global Trends 2030: Alternative Worlds*, 1.

⁷⁹ National Intelligence Council, *Global Trends 2030: Alternative Worlds*, 1.

⁸⁰ McElroy and Baker, quoted in "A New Harvard Report Probes Security Risks of Extreme Weather and Climate Change." (Harvard University Center for the Environment, October 2012), <http://environment.harvard.edu/climate-extremes>



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