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On the Front Lines: *Climate Change and the Combatant Commands*

By Commander Herbert E. Carmen, USN, Christine Parthemore
and Will Rogers



**Center for a
New American
Security**

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Cover Image

In April 2010, an Agricultural Development Team at Forward Operating Base Salerno in Afghanistan checks the health of wheat growing in Sabari during a joint patrol in Khowst Province.
(SGT. JEFFREY ALEXANDER/U.S. Army)

A P R I L 2 0 1 0

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As the U.S. military responds to the national security implications of climate change, the regional combatant commands will make the operational and tactical level decisions about how to adapt. Climate change, the 2010 Quadrennial Defense Review (QDR) observes, is “an accelerant of instability or conflict,” and could exacerbate trends such as coastal erosion, drought, crop failure, group grievance, uneven economic development and state illegitimacy. In every region of the world, the changing climate will influence political, social, economic, environmental and cultural trends in ways that could destabilize societies or exacerbate conflicts. These developments will present new challenges to combatant commanders and U.S. military and civilian officials operating in their respective areas of responsibility (AOR).

For example, extreme and extended drought in Afghanistan could undermine agricultural development, which President Obama has identified as a cornerstone to long-term stability there. However, it is not clear how, when and on what scale climate change may impact agriculture, which provinces will be most affected or what the United States should do in response. Meanwhile, the opening of the Arctic for commercial shipping and competition over resources will present new challenges, including how to navigate responsibility of the Arctic among overlapping regional combatant command jurisdictions.

Across the Department of Defense (DOD) and the military services, individuals are working to further understand and articulate the security consequences of climate change. This understanding, however, has not extended consistently or broadly to operational planners at the combatant command level. For a variety of reasons, many officials at the command level have yet to fully conceptualize how climate change could impact their AOR.

Yet, as operational leaders on the front lines, the U.S. unified combatant commanders’ roles require them to understand the impact of climate change and incorporate its effects into theater-level planning, coordination and execution. In concert with a range of emerging security threats, climate change is likely to affect many features of the future security environment and, as a result, efforts to plan for and equip America’s armed forces. In an April 2008 speech to the Association of American Universities in Washington, Secretary of Defense Robert M. Gates described some of the “new threats to national security” that will interact with climate change:

“Rather than one, single entity – the Soviet Union – and one, single animating ideology

– communism – we are instead facing challenges from multiple sources: a new, more malignant form of terrorism inspired by jihadist extremism, ethnic strife, disease, poverty, climate change, failed and failing states, resurgent powers, and so on. The contours of the international arena are much more complex than at any time during the Cold War. This stark reality – driven home in the years since September 11th – has led to a renewed focus on the overall structure and readiness of our government to deal with the threats of the 21st century.”¹

This paper focuses on the six geographic combatant commands as a way to address the effects of climate change and related energy security challenges on U.S. national security interests in regions across the globe. Because the geographic combatant commands are suitably positioned to observe physical environmental change and resulting effects, they also should be able to identify how these effects drive security requirements within their respective AORs.

Based on substantial independent research and personal interviews with representatives of each combatant command, this paper examines how projected environmental changes will intertwine with the political and economic dynamics that Secretary Gates identified as shaping the nature of future conflict. As the study of the security implications of climate change is relatively nascent, we relied on several relevant but more established data sets to analyze the relationship between environmental trends and political challenges. To gain an understanding of the impact of sea level rise on ports and cities, we describe the current and projected effects on selected cities and ports in each AOR using data from an Organisation for Economic Co-operation and Development (OECD) study. This study estimates the exposure of the world’s large port cities to coastal flooding due to rising sea level and increased – and perhaps more severe – storm

WHAT ARE THE UNIFIED COMBATANT COMMANDS?

The system of unified combatant commands began during World War II with the establishment of geographic areas of operations. After the war, President Harry S. Truman codified this arrangement in the first Unified Command Plan (UCP) in 1946. The UCP, a classified document that defines military command structure, establishes the missions and geographic responsibilities among the combatant commanders.

These commanders are responsible to the president and the secretary of defense for accomplishing the missions assigned to them and exercising command authority over the forces assigned to them. The military departments provide facilities and headquarters support, and they organize, train and equip forces to fulfill the combatant commanders’ operational mission requirements.

The unified command structure generated by the UCP is flexible and changes as required to accommodate evolving U.S. national security needs. President George W. Bush signed the latest change to the UCP in 2008 formally establishing missions and responsibilities for U.S. Africa Command (AFRICOM) and placing parts of the Caribbean in the U.S. Northern Command’s (NORTHCOM’s) AOR.

surge and damage due to high winds. Because climate change effects can drive or exacerbate instability, we examine data from the Failed States Index to identify the extent to which countries in that AOR already run a significant risk of collapse. Finally, we highlight the degree to which developing economies are vulnerable to climate change negatively impacting their agricultural industries, which serve as the sole income sources for large portions of certain populations. While

Chart 1: Unified Command Map of the Arctic



Source: National Geospatial-Intelligence Agency

this is an inexact method of examining what environmental pressures may become important to the combatant commands – especially given the dearth of extensive studies of causal relationships among these factors – it is meant to illustrate how climate change may interact with other security trends to challenge U.S. national security interests.

The following sections describe each combatant command; its mission and AOR; and relevant climate projections and economic and political assessments. We highlight unique characteristics of each combatant command that shed light on how the United States and the DOD will address future climate change challenges and resulting effects. We start by examining the Hawaii-based U.S. Pacific Command (PACOM) because it represents an important case study for considering the nexus of climate change, energy and security in a strategic forward operating location.

U.S. PACIFIC COMMAND

PACOM's AOR is vulnerable to a daunting range of potential repercussions of climate change in addition to traditional threats such as inter-state tensions, transnational crime and weapons proliferation.² PACOM is already experienced at helping partner countries deal with the effects of tsunamis, earthquakes and typhoons; but climate change could increase both the number and severity of natural disasters. In addition, a 2010 climate change assessment by Oak Ridge National Laboratory suggests several specific risks:

- Heat waves in China and Northern Australia are likely to increase over the next 40 years, and more expansively across the AOR over a longer timeline, with significant implications for agricultural output and food security.
- Flooding – a particular concern in major river areas – is likely to increase for much of PACOM's AOR due to increases in precipitation during the winter in some regions and during the summer in others.
- Sea level rise will very likely affect coastlines around the world, albeit unevenly, exposing people and infrastructure to flooding, erosion and storm impacts. Observed rates of sea level rise show effects to date are on pace with the high end of projections.³

Of even more direct relevance to PACOM, climate projections suggest that throughout this century, the Hawaiian and Pacific Islands (including the location of PACOM's headquarters) are likely to experience rainy seasons shifting from winter to summer months. This would likely increase rates of flooding, strain infrastructure and affect agriculture and freshwater supplies. According to a 2009 report by the U.S. Global Change Research Program (USGCRP):

In addition to gradual sea-level rise, extreme high water level events can result from a



combination of coastal processes. For example, the harbor in Honolulu, experienced the highest daily average sea level ever recorded in September 2003. This resulted from the combination of long-term sea-level rise, normal seasonal heating (which causes the volume of water to expand and thus the level of the sea to rise), seasonal high tide, and an ocean circulation event which temporarily raised local sea level. The interval between such extreme events has decreased from more than 20 years to approximately 5 years as average sea level has risen. ... Flooding related to sea-level rise and hurricanes and typhoons negatively affects port facilities and harbors, and causes closures of roads, airports, and bridges.⁴

Coastal flooding, erosion and contamination of freshwater supplies are major concerns throughout PACOM's AOR. Based on OECD statistics, of the current 10 coastal cities most at risk of being affected by sea level rise, six lie in PACOM's AOR: Guangzhou and Shanghai in China; Calcutta and Mumbai in India; Osaka-Kobe in Japan; and Ho

Chi Minh City in Vietnam. Mumbai is ranked most at risk, with nearly 2.8 million people (or 15.3 percent of the population) living within potential flood zones. Based on demographic, economic and environmental projections, within the next 60 years, eight of the 10 coastal cities with the most assets vulnerable to sea level rise will be in PACOM's AOR, amounting to more than 13.4 trillion dollars in assets that could be inundated by sea level rise. These projections also indicate that nine of the 10 coastal cities most at risk to sea level rise, ranked by population, will also be within the PACOM AOR.

Agriculture is also vulnerable to climate change, with potentially significant effects for developing economies in the region. Indeed, nine countries in PACOM's AOR depend on agriculture for more than 25 percent of their gross domestic product (GDP), while another four depend on agriculture for at least 20 percent of their GDP.⁶ Given that the global average is approximately 6 percent, this outsized dependence on agriculture for economic stability could represent a significant vulnerability if projected climate changes impede agricultural productivity. Meanwhile, water scarcity could impact agricultural development for other Southeast Asian states, such as Thailand, where water resources are already being strained by regional upstream dam building.⁷

Climate change carries the potential to affect political stability within the region as well. While the Asia-Pacific is not characterized by state weakness to the degrees seen in parts of U.S. Central Command's (CENTCOM) and Africa Command's (AFRICOM) AORs, according to the Failed States Index three states in this AOR are ranked among the top 20 "critical" states at risk of failure, including Burma, North Korea and Bangladesh. Meanwhile, three others – Nepal, Solomon Islands and Sri Lanka – are ranked as "in danger" of state failure. Even with relative

PACOM HQ'S DUEL ENERGY AND CLIMATE CHALLENGES

Hawaii, where the Pacific Command is headquartered, possesses unique vulnerabilities related to its energy dependencies and susceptibility to the effects of climate change. It uniquely showcases how energy consumption and the consequences of that consumption are linked.

Hawaii (and therefore PACOM) depends heavily on petroleum to meet its energy needs – and not only for transportation. About 90 percent of its energy needs, including the production of three fourths of its electricity, are met by petroleum. The state accounts for only about one-third of one percent of total U.S. electricity generation, but accounts for almost half of the country's electricity generation that is produced by petroleum. As this petroleum is often shipped through vulnerable shipping routes and the state lacks energy pipeline infrastructure, most energy imports to the state come through a single point: Honolulu. Adding to the vulnerabilities, the state's electric grids are notoriously weak. Luckily, the state does enjoy high potential capacity for wind, solar, geothermal and wave power, and DOD officials are contributing to Hawaii's ability to tap into these resources.⁹ The military installations in Hawaii have made strong advances in energy efficiency, alternative energy and environmental considerations, and have tested everything from hydrogen fuel cell, electric and hybrid vehicles to various types of solar roofs.

Several institutions are facilitating PACOM's partnership with local actors and other federal departments to address Hawaii's energy and climate vulnerabilities. One coordinating body, the Hawaii Clean Energy Initiative (HCEI), a state partnership with Department of Energy (DOE) established in 2008, is intended to reduce this high dependence on petroleum, both to reduce vulnerability to price spikes and supply disruptions, and to reduce resulting greenhouse gas emissions.¹⁰ Several national labs also contribute actively to Hawaii's and PACOM's energy and climate goals. The labs provide assessments and model options for mitigating grid and other vulnerabilities, and are creating a master plan on how to meet energy security goals. In January 2009, PACOM established its Energy Partnership and Strategy Council (PEPSC), a council that convenes relevant stakeholders from the military services and other federal departments along with state and local officials to coordinate on energy issues. As with any endeavor, opinions regarding its utility vary and the parties involved still struggle with differing visions of energy security; but PEPSC seems to be useful for uniting the services in their attempts to conserve energy – a vital first step.

Indeed, as a result of its work, PACOM released an energy strategy in October 2009 outlining steps that

will contribute to meeting Hawaii's goals of supplying 70 percent of state energy demands through clean energy by 2030 or sooner, and reducing overall demand for energy through conservation and efficiency. This strategy also acknowledges that addressing energy and climate concerns effectively at home can provide the experience it needs to lead similar efforts elsewhere in its AOR: "Today's energy landscape offers a once-in-a-generation chance to set a positive path for the entire Asia Pacific region."¹¹ These lessons are also applicable elsewhere in DOD, and through these efforts and others, PACOM can provide an abundance of information on the effects of climate change and clean energy options for mitigating emissions that are relevant to other combatant commands.

Interagency activities at PACOM show that working-level partnerships are critical and provide useful lessons about how to coordinate with DOE and other agencies to fund initiatives, and what knowledge and technical capabilities others can contribute to assist PACOM in meeting its needs. PACOM and the military services seem advanced in coordinating amongst themselves and with universities, private companies, and state and local government offices. Across our interviews, nearly every individual mentioned partnerships like the HCEI, PEPSC and others.

stability in this region, primary drivers such as group grievance, demographic pressure, uneven economic development and state legitimacy are key concerns that could pair with changing climatic conditions to create new challenges for PACOM.⁸

Effectively assessing and managing these effects of climate change will require PACOM to coordinate with other U.S. agencies. The work that PACOM has already done addressing climate change and energy security at its Honolulu headquarters will serve as a strong foundation and offer useful lessons in how it may further partner with agencies such as the Department of Energy (DOE), U.S. Agency for International Development (USAID) and the U.S. Department of Agriculture (USDA) in order to better address the climate change challenges in its AOR.

Recommendations for PACOM: Despite the helpful experience and institutions PACOM has developed to handle climate change-related challenges, with the largest AOR in terms of geographic area and population, PACOM will need to prioritize its efforts. As it develops long-term plans for its AOR, particularly the coastal nations along the Bay of Bengal and the western Pacific Ocean, it should identify those areas where changing demographics and work force migrations may lead to even greater risk to populations in coastal areas as the effects of sea level rise impact those areas. Early identification may allow planners to find ways to mitigate potential instability which could be exacerbated by these climate change effects.

U.S. CENTRAL COMMAND

Current climate observations suggest that countries within CENTCOM's AOR are likely to feel heavy effects of climate change. Indeed, environmental conditions and climatic dynamics are likely to shape this region for the next several decades. Though climate projections to date often lack detailed timelines and state-level analyses, scientists do largely agree on several key trends:

- A pattern of drought, which is by far the most dominant climate hazard in the region, especially in Central Asia.
- Reduced precipitation in Central Asia, and increased precipitation over the Arabian Peninsula.
- Extreme heat waves that have the potential to disrupt agricultural development.
- Increased melting of regional glaciers that are a significant source of water for rivers, lakes, reservoirs and subsurface aquifers.
- Increase in tropical cyclones in the Karachi region of Pakistan.
- Sea level rise coupled with more frequent storms are projected to increase the damage to coastal communities.

While coastal communities in CENTCOM's AOR will be vulnerable to the effects of rising sea levels, the changes are not likely to be as acute as in other regions in the world, such as Southeast Asia and the Caribbean. Two notable exceptions are already at risk of flooding: Alexandria, Egypt and the city of Dubai. In Alexandria approximately 1.3 million people are already at risk of flooding due to rising sea level. Current observations along with projected population trends suggest that nearly 4.4 million people will be vulnerable to sea level rise by 2070. By comparison, in Dubai, 260,000 people are currently at risk of flooding due to sea level rise, increasing to approximately 793,000 by 2070.¹² While these

U.S. Central Command Quick Facts (CENTCOM)

- **Headquarters in Tampa, Fla. and Qatar, with several subordinate and service component headquarters located across the AOR.**
- **20 countries within the AOR.**
- **Oversees combat operations in Afghanistan and Iraq.**
- **Commands more than 210,000 U.S. service personnel in the region.**

communities are generally well-developed and have better governance structures than many others in CENTCOM's AOR, unanticipated challenges (such as severe and potentially more frequent storms and coastal inundation) have the potential to corrode economic development and political establishments while exacerbating existing social grievances.

Several CENTCOM countries critical to U.S. interests in this AOR suffer from ongoing conflict, weak governance and instability – factors that could be made worse by climate change or that may complicate efforts to adapt to the effects of climate change. In the Failed States Index, Iraq, Afghanistan and Pakistan are characterized as “critically” close to state failure and ranked sixth, seventh and tenth, respectively. Of the drivers undermining Iraqi and Afghan stability, top concerns are external intervention from state or non-state actors affecting the internal balance of power, group grievance (i.e., marginalized communities) and the legitimacy

of the state. Meanwhile, Yemen, which is plagued by uneven development and factionalized politics that undermine state legitimacy, is ranked nineteenth on the Failed States Index, with four other states in the AOR ranked as “in danger” of state failure due to human rights and state legitimacy concerns.¹³

To ensure long-term stability in this AOR, military, development and diplomacy professionals will need to understand what a changing climate could mean for agricultural productivity and related water supply issues. In a surprise visit to Afghanistan on March 28, 2010, President Obama spoke to the role that the strength of agricultural production is likely to play in Afghanistan and Pakistan, which depend on agriculture for 31 percent and 21 percent of their GDPs, respectively. As Obama conveyed to U.S. troops, investing in civilian areas such as agricultural production will increase Afghanistan's prosperity, security and independence from extremists in the region.¹⁴ Yet, as projected drought and heat waves set in, agricultural sectors in Afghanistan, Pakistan and other countries in the AOR could be affected.

According to the Environmental Protection Agency (EPA), “An increase in average temperature can 1) lengthen the growing season in regions with a relatively cool spring and fall; 2) adversely affect crops in regions where summer heat already limits production; 3) increase soil evaporation rates, and 4) increase the chances of severe droughts.”¹⁵

Effects on agriculture have the potential to worsen food scarcity in states that are already having difficulty meeting demand. For example, concerns surrounding access to food have already sparked several Middle Eastern countries to lease large tracts of land throughout Africa and Southeast Asia, in part to grow food to meet their own sustenance needs. These include

CLIMATE CHANGE AND SECURITY IN AFGHANISTAN, IRAQ AND YEMEN

The priorities established by CENTCOM in its 2010 Posture Statement offer a guide to where officials see the most immediate need for the command's attention.

Afghanistan

General Petraeus reiterated Afghanistan's importance to U.S. national interests in his testimony in March 2010. In Afghanistan, U.S. goals "are to disrupt, dismantle, and defeat al-Qaeda and its extremist allies and to set conditions in Afghanistan to prevent reestablishment of trans-national extremist sanctuaries like one al-Qaeda enjoyed there prior to 9/11."²⁰ Central to this effort is building civilian capacity to support sustainable livelihoods – and it is well worth thinking through how the effects of climate change may interact with these goals.

While it is not yet clear how climate change will directly affect Afghanistan, observations suggest that climate change could potentially disrupt agricultural development by exacerbating drought (i.e., a decline in surface or subsurface water resources, such as rivers, lakes, reservoirs and ground water) and increasing the severity and frequency of heat waves. According to the U.S. Geological Survey (USGS), Afghanistan's hydrology is largely dependent on runoff from ice caps and glaciers that supply many of its rivers with fresh water. However, the USGS reports that "[c]hanging climate is resulting in increased melting of these glaciers and increasing discharge while reducing the volume of water remaining in glacier storage. Most glaciers in this region are retreating and/or down-wasting rapidly."²¹ Meanwhile, unsustainable irrigation practices and poor water governance will increasingly constrain storage and access to fresh water necessary for Afghan farmers to grow their crops. Heat waves are also expected to be particularly severe in Central Asia.²² Extreme variations in heat can potentially disrupt crop development, especially with species sensitive to strong variations in temperature. While it is still unclear how climate change will affect Afghanistan's agricultural productivity, given that agricultural development and related water supply issues will be a cornerstone to long-term stability, military, development and diplomacy professionals operating in Afghanistan will need to understand these effects.



A California Army National Guardsman gathers a soil sample near Marawara, Afghanistan to learn how crop production can be improved in the area.
(TECH. SGT. BRIAN BOISVERT/Army National Guard)

Iraq

While security in Iraq has improved significantly, General Petraeus has noted that "the progress in Iraq is still fragile." In addition to the many social, cultural and political challenges likely to shape Iraq in the coming years, access to water and agricultural development are likely to affect the security environment – especially if climate change exacerbates drought and increases temperatures throughout the region. Like many of its neighbors, Iraq depends a great deal on water sources primarily from the Tigris and Euphrates rivers that flow from its northern neighbors Syria and Turkey. In the last year, Iraq suffered the most acute drought in recent history, leaving 2 million Iraqis vulnerable to electricity outages due to declines in hydroelectric power generation, and nearly as many parched without adequate access to fresh water.²³ Dr. Abdul Latif Rashid, Iraq's water minister, reported that 300,000 marshland residents had been displaced by drought in recent years.²⁴ Meanwhile, the UN Educational, Scientific and Cultural Organization (UNESCO) reported that more than 100,000 Iraqis had been internally displaced by drought since 2005.²⁵ Furthermore, 70 percent of the historic subterranean aqueducts, or karez, which had historically supplied hundreds of communities with access to

fresh water, have been depleted due to drought and unsustainable pumping.²⁶

Whether it is for power generation, consumption or agricultural production, access to water is likely to play a crucial role in shaping Iraq's future. As in Afghanistan and Pakistan, climate-induced drought and heat waves could affect water availability. While it is projected that annual precipitation will increase over the Arabian Peninsula, it is not clear whether Iraq's existing irrigation infrastructure and water management practices will allow the Iraqi people to harness increases in annual rainfall. Furthermore, existing projections are unclear as to where increased precipitation may occur (i.e., if the northern provinces will benefit over the southern provinces, or vice versa). Finally, in examining the region as a whole, Iraq could be vulnerable to its northern neighbors' adaptation practices; specifically, Turkey and Syria may choose to reduce the flow of the Tigris and Euphrates into Iraq in order to adapt to changes in the climate. Regardless, as U.S. military planners look at contingencies in Iraq for the near future they should factor in water trends and how climate change may engage these trends.

Yemen

Yemen is an important country for CENTCOM to monitor. "In Yemen, we have seen an increase in the prominence of al-Qaeda as it exploits the country's security, economic, and social challenges," said General Petraeus. Indeed, Yemen's security, economic and social challenges are rooted in the state's natural resource management, and climate change could make managing these resources a nearly impossible task.

Today, Yemen – one of the most water impoverished states in the world – is experiencing an acute drought that is increasingly undermining the country's already fragile government. As The New York Times reported in November 2009, Yemen's water crisis is one that "threatens the very survival of this arid, overpopulated country, and one that could prove deadlier than the better known resurgence of Al Qaeda [there]."²⁷ Yet there are ways in which Yemen's declining water availability and the resurgence of al Qaeda show overlap. To date, the Yemeni government has been able to

stave off a political and social meltdown by using its oil wealth, which accounts for approximately 85 percent of the government's revenue, to subsidize expensive – but necessary – diesel pumps to extract water from deep aquifers. But the country is running out of oil. In fact, experts predict that by 2017, the government will run out of exportable oil, leaving it without the means to continue subsidizing its expensive, unsustainable water practices. Meanwhile, as water prices increase in Yemen – having quadrupled since 2005 – many of the country's farmers are turning to plant qat, a profitable narcotics plant popular in Yemen.²⁸ This water intensive plant is drying up the country, with more than 50 percent of the country's available water being used to irrigate qat farms.²⁹ At the same time that water becomes scarcer, the government is increasingly unable to maintain control and legitimacy over all of its governorates, leaving pockets of ungoverned spaces for al Qaeda to exploit.

As drought is projected to become worse with changes in the global climate, Yemen could experience a situation of absolute scarcity where the Yemeni government is unable to provide access to water. The potential for al Qaeda and other transnational actors to exploit this vulnerability could be more prominent. In order for officials at CENTCOM to adapt to the effects of climate change in Yemen, they will need access to better scientific projections that give them insight into the conditions and dynamics that are likely to shape the future security environment.

Bahrain, Jordan, Kuwait, Qatar, Saudi Arabia and United Arab Emirates.¹⁶

Recommendations for CENTCOM: CENTCOM should examine the local and regional projected climate change on water for its AOR, as it will affect all other environmental change in the region. Combined with other dynamics – instability, domestic tensions and broad environmental change – water pressures are likely to carry important implications for CENTCOM. CENTCOM's focus on population-centric efforts to achieve security objectives necessitates many of the quality of life initiatives already underway, but it is important to look at how challenges such as water scarcity will further develop over time and to plan for those future capacity requirements now.

Today, military units in Afghanistan are drilling for potable water, in some cases more than 1,200 feet below the surface,¹⁷ in order to reduce the military's demand for bottled water in the field. The U.S. military's outsized dependence on water to sustain combat operations is a significant operational challenge, accounting for 51 percent of the logistical burden in Afghanistan.¹⁸ Glacier melting, drought and acute water scarcity could further challenge the military's ability to find sufficient sources in this AOR, and CENTCOM's long-term planning must account for this contingency. Indeed, drought is likely to be the most pronounced climate hazard to countries within CENTCOM's AOR.¹⁹

U.S. EUROPEAN COMMAND

Changes to the European climate have been observed in every corner of the continent. Because EUCOM forces are stationed across all parts of Europe and because climate change effects are notably different across the continent, EUCOM installations will likely experience a spectrum of effects from climate change. Some of these are already well documented and include:

- General warming across Europe at a slightly higher rate than the global average.
- Slightly higher warming in mountainous areas and the southwestern part of Europe as compared to the rest of Europe as a whole.
- Precipitation increase of 20 percent during the twentieth century in the already wet northern areas of Europe.
- Precipitation decrease of as much as 20 percent in some areas of southern Europe.
- Increased river flows in the north.
- Decreased river flows in the south.
- Increased risk of desertification in the southern areas of Europe, particularly Spain and Greece.
- Loss of two-thirds of the volume of Alpine glaciers since 1850.
- Steady decrease in Alpine snow cover in each of the past four decades.
- Decreased permafrost in the northern regions, which may lead to the damage of high-mountain infrastructure.³⁰

The most strategically meaningful manifestation of climate change is decreased ice levels in the Arctic Ocean. The prospect of easier access opens the Arctic for large-scale economic activity, including access to shipping routes previously blocked by ice and access to what could possibly be vast natural resources underneath the sea.

U.S. European Command Quick Facts (EUCOM)

- **Headquarters in Stuttgart, Germany.**
- **AOR includes Greenland, all of Europe (including all of Russia) and Israel for a total of 51 countries, 21 million square miles.**
- **AOR includes one-eighth of the world's population and about one-fourth of the world's gross domestic product.**
- **Approximately 80,000 U.S. military personnel are stationed in Europe today.**
- **The EUCOM commander also serves as the Supreme Allied Commander Europe (SACEUR) and maintains his headquarters in Mons, Belgium.**

Much of these natural resources are likely to be found in the Exclusive Economic Zones (EEZs) of the bordering states – Canada, Denmark, Greenland, Norway, Russia and the United States. Under the United Nations Convention on the Law of the Sea (UNCLOS), nations are entitled to an EEZ reaching 200 nautical miles from the coastline. Countries may also exercise sovereign rights over the physical continental shelf in areas beyond the EEZ under Article 76. The U.N. Commission on the Limits of the Continental Shelf has authority to make the final recommendation based on the evidence presented.

This increased activity will likely lead to an increased military presence both to ensure access to the sea lines of communication and to protect the sovereignty of each nation's EEZ. Because of the tremendous economic potential in the Arctic region, there is potential for cooperation, competition and conflict simultaneously. In the near term, the Arctic Council may be the logical forum to adjudicate grievances associated with an opening Arctic. The Arctic Council is an intergovernmental forum of all the Arctic states (Canada, Denmark, Finland, Iceland, Norway, Russian, Sweden, and the United States) that promotes cooperation, coordination and interaction on issues related to sustainable development and environmental protection.³¹ Because the council executes decisions on the principle of consensus, giving each of the eight Arctic states veto power, decisions generally represent the national interests of individual states. This helps the council and member states navigate issues of enforcement, and it is an example of a formal, legitimate governing body in the Arctic.

America's European partners are working to improve capabilities for monitoring the pace and physical effects of the melting sea ice, which will afford EUCOM better information for planning purposes. Indeed, precisely measuring the warning signs of a changing climate is critical to accurately determining the current impacts and creating useful models for future predictions. To measure the effects of melting sea ice, for example, the European Space Agency recently launched CryoSat 2, which will measure ice thickness to within one centimeter. The data from CryoSat 2 can then be used to gain a more accurate understanding of the prospect of future sea level rise and other effects.³²

Resulting from melting Arctic ice and other effects of the changing climate, sea level rise is projected to affect populations and infrastructure in EUCOM's AOR. In particular, the

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Netherlands – a low-lying state with more than 25 percent of the country below sea level – will be affected. Today, 73 percent of Amsterdam’s population (839,000 people) is currently at risk of flooding, in addition to 128 billion dollars in assets. Rotterdam fares similarly, with 68.3 percent of the population (752,000 people) and 114.8 billion dollars in assets at risk from sea level rise.³³ Future projections suggest that as sea level rises, Amsterdam and Rotterdam will see dramatic increases in vulnerability to the population and assets. While the Netherlands government and many other cities in EUCOM’s AOR are planning to adapt to sea level rise with investments in coastal walls, dikes and levees, according to a QDR background report “the most significant impact of sea level on coastal regions is likely not the gradual erosion accompanying an increase in sea level, but the episodic sometimes dramatic erosion and other damage accompanying coastal storms and storm surge.”³⁴

The effects of climate change will also alter European agriculture in various ways. In EUCOM’s AOR, agriculture will likely represent less of a vulnerability to economic sustainability as climate change comes to pass, due, in part, to the diverse economies within the command’s

AOR. Notable outliers include Moldova and Albania, which depend on agriculture for 20 percent of their GDP.³⁵ Indeed, as projected drought and heat waves set in throughout Europe, these countries’ agricultural sectors may be particularly vulnerable. In general, changes in the climate have the potential to undermine domestic agricultural output, which could drive up food prices as well.

As the world’s second largest consumer of energy, the European Union (EU) considers energy security essential to sustaining peace and security. In 2007, the EU imported 53 percent of its total energy requirements, including 83 percent of its crude oil requirements, and 60 percent of its natural gas needs. The EU is largely dependent on Russia for these imports, with 34 percent of imported crude oil and 40 percent of imported natural gas coming from Russia. By comparison, Persian Gulf states provided the EU with 19 percent of its crude oil imports in 2007.³⁶ This reliance on Russia for European energy consumption is perhaps the biggest security challenge on the European continent, as Russia can generate political troubles and constrain policy. Thus, understanding the centrality of European energy security is critical to properly formulating and framing U.S. climate policies and EUCOM plans related to climate change.

Russia holds many of the cards with regard to energy security in Europe. The Russian Federation enjoys a massive reserve of oil and natural gas. The lowest estimates assume that Russia has at least 60 billion barrels of crude oil in reserve and some 1,700 trillion cubic feet of natural gas. Russia has used energy exports to begin to fund military modernization, develop infrastructure and build partnerships around the periphery of Russia. This abundance creates vulnerabilities for the many European countries that rely on Russian energy. Tumbling prices in the global natural gas market have put pressure

on Russian companies and the greater Russian economy in recent years. A need for cash has also led to politico-economic disputes between natural gas companies in the Ukraine and Russia over contracts, prices, non-payment and debt. These disputes, which have persisted in one form or another for nearly two decades, have resulted in several interruptions of natural gas supply to Europe.

Recommendation for EUCOM: NATO Secretary General Anders Fogh Rasmussen recently identified the protection of energy supplies and the security implications of climate change as areas requiring further cooperation among NATO members, noting that “we can only cope with these challenges if we work together.”³⁷ EUCOM, with a staff directorate tailored for interagency cooperation and a commander that is dual-hatted as Supreme Allied Commander Europe (SACEUR), is well positioned to collaborate on the challenges of energy security and climate change with Europeans.

We recommend that EUCOM focus on leveraging its capacities for U.S. interagency collaboration in order to help facilitate technology sharing and international cooperation aimed at the dual energy and climate change challenge. An important step in strengthening cooperation between the United States and Europe was the U.S. creation of the EUCOM Interagency Partnering Directorate as part of the recent EUCOM staff reorganization. This directorate hosts representatives from U.S. agencies such as USAID, the Department of State (DOS), the Department of the Treasury, and the Immigration and Customs Enforcement Agency (ICE). The Interagency Partnering Directorate intends to add other agency representatives later this year, including representatives from the DOE.³⁸ For addressing challenges resulting from the effects of climate change, this kind of interagency structure will be critical for accessing the best scientific projections and leveraging existing U.S. capabilities to mitigate emissions and adapt to change.

U.S. Africa Command Quick Facts (AFRICOM)

- **Headquarters in Stuttgart, Germany.**
- **53 countries in its AOR, including every African country except Egypt.**
- **AOR spans an area three and half times the continental United States and includes more than 1 billion people.**
- **Became fully operational as a combatant command on October 1, 2008.**
- **Responsibility for U.S. military and U.S government missions in Africa and is unique in its makeup.**
- **Required to be half staffed by civilian billets, including professionals from non-military organizations.**

U.S. AFRICA COMMAND

President Obama, speaking before the Ghanaian Parliament in July 2009, declared that Africa “is the most threatened by climate change.” According to the president, “[a] warming planet will spread disease, shrink water resources, and deplete crops, creating conditions that produce more famine and more conflict.” Indeed, scientists have built consensus on several key trends that are likely to shape AFRICOM’s AOR:

Drought hazard could be widespread across the AOR and “of greatest intensity in the Sahel, along the Somalia-Kenya border, and in an areas [sic] surrounding the Okavango

UNDERSTANDING CLIMATE CHANGE AND CONFLICT IN AFRICA

The DOD and key elements of the U.S. national security community recognize that understanding the security implications of climate change will be necessary for promoting U.S. interests in Africa. In North Africa, where AFRICOM supports operations to counter violent extremism through Operation Enduring Freedom-Trans Sahara (OEF-TS), Combined Joint Task Force Horn of Africa and other partner capacity building missions, analysts with the NIC collected and analyzed data to assess how climate change could impact North Africa in a follow up report to the 2008 National Intelligence Assessment on the National Security Implications of Global Climate Change to 2030. Security analysts understand that the effects of climate change have the potential to weaken already fragile governments and to create the conditions that can be exploited by transnational actors such as al Qaeda, and other regional terrorist groups, such as al-Shabaab in Somalia.

In an effort to better understand how climate change will affect African states, the DOD's Minerva Initiative – a DOD-sponsored, university-based social science research program – awarded a 7.6 million dollar grant to the University of Texas, Austin to conduct a multiyear effort to study the security consequences of climate change in Africa. The program, Climate Change and African Political Stability, "will identify whether climate change could trigger disasters that undermine state stability, define strategies for building African state capacity and assess global development aid response efforts."⁶¹ Such partnerships between government and academia have the potential to fill in the holes in much-needed national security research and provide AFRICOM officials with the data they need to plan for future contingencies in the security environment.

and Kalahari Desert: southern Angola, northern Botswana, and southern Namibia."⁴⁰

Increased incidence of wildfires could occur, especially in areas where drought and heat waves are most acute.

The frequency and intensity of tropical cyclones may increase, and in particular, "[t]he island of Madagascar and the coast of Mozambique [which] experience tropical cyclones that develop over the Indian Ocean," could be increasingly vulnerable.⁴¹

More frequent severe droughts and heat waves could increase the incidence of water scarcity by affecting precipitation patterns and hydrological resources such as lakes, rivers and underground aquifers, though patterns of increased precipitation may occur within the AOR as well.

An increase in the incidence of vector-borne disease, particularly malaria, may occur in a warming climate, especially in high-elevation regions such as East Africa.⁴²

Sea level rise may be an important effect of climate change for AFRICOM's AOR, especially along the coast where urbanization is expected to continue to accelerate. Today, along the coast of Benin, sea level rise has led to the destruction of roads, crops and hundreds of homes, and it now threatens the capital city of Cotonou.⁴³

Projections indicate that sea level rise could affect economic growth and exacerbate existing social grievances in already afflicted cities. For example, according to OECD statistics, in Mogadishu, the number of Somalis vulnerable to rising sea level is projected to increase 12 times by 2070, from 9,000 people at risk to 115,000. Meanwhile, in Lagos, Nigeria, the number of residents vulnerable to sea level rise will increase 9 times over the same period, from 357,000 to 3.2 million.⁴⁴ Conflict, instability and piracy in Somalia are fueled, in part, by a threatened fishing industry that could

be more afflicted changing ocean conditions. Nigeria's oil industry, which provides for 80 percent of the government's revenue,⁴⁵ may be affected by rising sea level and more frequent and more severe storms. These storms have the potential to damage or destroy offshore oil platforms near Lagos, which are expected to provide significant oil production in the near future. The decline in oil revenue could become a destabilizing factor that could promote the spread of violent extremism in Nigeria.

Linked to this AOR's water issues, agricultural productivity (and its relationship to achieving sustainable economic development goals) is of high concern. One report by the Africa Partnership Forum (led by the OECD) reported that "Africa is particularly vulnerable to climate change because of its overdependence on rain-fed agriculture, compounded by factors such as widespread poverty and weak capacity."⁴⁶ Indeed, as mentioned before, current climate observations suggest that drought, heat waves and wildfires will plague states within AFRICOM's AOR.⁴⁷

These conditions stand to potentially degrade agricultural development, including by further straining water resources, which could have dramatic consequences for populations of agriculture-dependent economies within this AOR. Of the 53 states in AFRICOM's AOR, 23 states depend on agriculture to support at least 25 percent of their GDP, with six states dependent on agriculture to support 55 percent or more of their GDP. Of those countries, Guinea-Bissau, Somalia and Liberia tip the scale, with agriculture contributing to 62 percent, 65 percent and 77 percent of their GDPs, respectively.⁴⁸ Meanwhile, extreme population growth coupled with unsustainable water management practices will likely strain existing freshwater resources, given that 34 of the 40 states with the highest population growth in the world are located

within AFRICOM's AOR.⁴⁹ As the U.S. National Intelligence Council (NIC) describes, the effects on agriculture will likely be severe unless African communities develop "[a]daptation strategies, including modifications in sowing dates to match climate changes and development of heat-tolerant crop varieties."⁵⁰ Given all of these factors, AFRICOM officials will also need to assess how climate change could affect pandemic disease trends, and how this could challenge military readiness for the state militaries that AFRICOM is engaged with in building security capacity.

Shrinking crop production will not only undermine economic development, but also sustainable livelihoods, which could weaken government legitimacy and exacerbate existing grievances that have the potential to lead to conflict. According to the 2009 Global Hunger Index, seven states in AFRICOM's AOR are ranked "extremely alarming" on the hunger severity index, with another 16 states ranked in the "alarming" category.⁵¹ Indeed, food riots are already prevalent in many African states. Further complicating the situation, the political sensitivities associated with access to food and arable land have led to the recent deposing of at least one government in Africa and could shape political environments in the future.⁵²

DOD officials, since before AFRICOM's inception, have defined the core responsibility in this region as to "prevent problems from becoming crises, and crises from becoming conflicts."⁵³ This is extremely challenging. To illustrate the sheer scale of the African continent, Cape Town, South Africa at Africa's southern tip is as distant from AFRICOM's headquarters in Stuttgart, Germany as Stuttgart is from Hong Kong. Africa is politically, culturally and socially diverse, with 800 ethnic groups and 1,000 different languages.⁵⁴ Given the complexity and dynamic nature of Africa's strategic environment, officials

recognized that AFRICOM would have to be a distinct unified combatant command, designed to directly support an interagency effort that supports development and diplomacy missions in addition to military operations. While AFRICOM is in the command chain of the DOD, it coordinates closely with its State Department and USAID partners. This is exemplified in the command structure, which includes a civilian deputy for civilian-military affairs and an unprecedented number of billets – half – for civilian employees, including non-military agencies of the U.S. government.⁵⁵ According to the 2010 Posture Statement, “Africa’s challenges require a holistic view of security that includes defense, law enforcement, and customs and border security. Addressing defense-related challenges must be pursued in concert with other U.S. government and partner security-related endeavors to sustain unity of effort.”⁵⁶

Africa’s strategic environment is shaped by complex and dynamic challenges, including transnational threats such as violent extremism; ethnic tensions; illicit trafficking in drugs, weapons and humans; piracy; pandemic disease; extreme poverty; resource scarcity; and the lack of rule of law and democracy. Of the top 10 ranked states in the Failed States Index, seven states lie in AFRICOM’s AOR: Somalia, Zimbabwe, Sudan, Chad, Democratic Republic of the Congo, Central African Republic and Guinea.⁵⁷ These challenges contribute to the drivers of instability associated with these states, including uneven economic development, group grievances (in particular, ethnic tensions), human rights abuses, a general lack of public services, and the illegitimacy of state authority. Today, AFRICOM officials are focused on addressing these challenges through sustained military-military, civilian-military, and civilian-civilian partnerships with African countries that: promote capacity building of conventional military

forces through combined training and exercises; foster strong strategic relationships that sustain the benefits of capacity building efforts; promote regional cooperation and interoperability; counter violent extremism; contribute to stability in current conflict zones; and prevent the conditions that contribute to conflict.⁵⁸ According to the 2010 AFRICOM Posture Statement, “[t]hreats to stability do not necessarily manifest themselves in conflict, but can nevertheless have a corrosive influence on the development of good governance, viable market economies, and effective security sectors.”⁵⁹

Recommendation for AFRICOM: Given the potential for climate change to exacerbate existing challenges to improving security and stability within AFRICOM’s AOR, of all the unified combatant commands, AFRICOM and its partner agencies should focus attention first on how to assist African countries to adapt to the effects of climate change. AFRICOM’s interagency structure will likely lend itself to support DOD’s climate change efforts, as envisioned by the QDR, which stated that “[m]anaging the national security effects of climate change will require DOD to work collaboratively, through a whole-of-government approach, with both traditional allies and new partners.”⁶⁰

AFRICOM, in its role of supporting African efforts to provide for Africa’s security and development, should learn how climate change affects the continent today and in the future and include that knowledge in planning assistance efforts. AFRICOM can help Embassy Country Teams and African governments develop and prioritize initiatives that can help adapt to and mitigate the effects of climate change on Africa’s security environment through its Offices of Defense Cooperation. A thorough understanding of climate change can help AFRICOM help its African partners to proactively address climate

change impacts that will threaten stability and development.

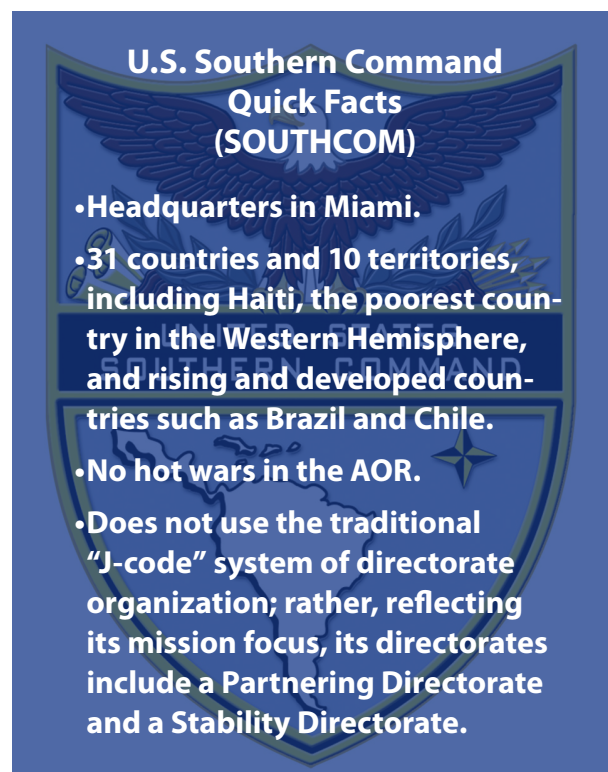
U.S. SOUTHERN COMMAND

According to one U.S. Southern Command (SOUTHCOM) official, climate change will be a “huge consideration” in this AOR, but difficulties in projecting likely effects of climate change remain. Though climate projections to date still often lack detailed timelines and geographically specific effects, scientists agree that several general trends are likely to affect Central and South America, including:

- A general increase in wildfires, particularly in and around Brazil.
- A general wetting along the tropical Pacific and Atlantic coasts and in southern Chile.
- Increased drought and risk of desertification in Central America.
- Increased precipitation along the equatorial Pacific coast and southern Brazil, Uruguay, and northern Argentina on the Atlantic coast.
- Erosion, salt water intrusion, flooding and damage from storm surges.
- Observed sea level rise, which to date outpaces most projections.⁶²

Indeed, one SOUTHCOM representative noted in a recent speech that several of its AOR’s top challenges include “climate, energy, water, and food.”⁶³ And as described in SOUTHCOM’s most recent Posture Statement, its challenges “include a broad and growing spectrum of public security threats, the possibility of natural and man-made disasters, and an emerging class of issues, such as those relating to the environment.”⁶⁴

The effects of climate change are likely to manifest in several ways for SOUTHCOM. Since climate change is likely to increase the severity



and frequency of major weather events, several SOUTHCOM officials noted that these issues can also drive missions such as Humanitarian Assistance/Disaster Relief (HA/DR). Natural disasters in already unstable regions, combined with broader environmental and resource pressures, may combine with more traditional national security threats. For instance, they may increasingly trigger population displacement and migration, which could further complicate efforts to control cross-border illicit activities such as smuggling. Many gangs and illicit networks involved in narcotics trade and other criminal activities are also involved with oil theft and sabotage of infrastructure related to resources trade within SOUTHCOM’s AOR.

Moreover, since SOUTHCOM presently has no interstate wars within its AOR, in recent years, SOUTHCOM has focused on soft power and engagement in order to enable stability the

region and contribute to positive relationships with the United States. Addressing the effects of climate change in its AOR could provide SOUTHCOM with opportunities to strengthen this focus, given that SOUTHCOM's engagement with countries in its AOR already centers often on issues related to natural resources and science and technology collaboration. To address the negative consequences of climate change, SOUTHCOM and its partner countries can plan jointly for environmental change. Joint research and data collection can provide good opportunities for positive international cooperation, and U.S., Central American and South American militaries can learn from one another's scientific and information gathering capabilities in order to better advance the abilities of all countries to plan for potential effects of climate change. The USNS Henson, for example, recently engaged with a team of Brazilian Navy sailors to share oceanographic and bathymetric survey methods.⁶⁵ Finally, they can collect data on which areas are prone to different types of natural disasters, mudslides and flooding. In addition, SOUTHCOM has begun to invest in renewable energy production near its headquarters and within its AOR, including solar and biodiesel projects in Honduras and the Dominican Republic.

Recommendations for SOUTHCOM: In addition to continuing this kind of science and technology engagement, SOUTHCOM should also identify which climate change effects could influence the challenges already identified in its unclassified strategy document, United States Southern Command Strategy 2018, and apply that analysis to its Theater Campaign Plan (TCP). In addition to identifying climate change effects that might lead to HA/DR missions, planners could identify areas in Central America that may require improved irrigation in the event of drought and work with partners in the development community to minimize negative repercussions of

drought before they transpire. They might also identify port facilities in the AOR that require upgrading or reinforcement before damage from flooding or storm surges occurs. Such planning could then be used to develop the Prioritized Required Capabilities List in the TCP. Doing so will enhance SOUTHCOM's ability to develop solutions to the very real challenges of this region.

U.S. NORTHERN COMMAND

Climate projections for the NORTHCOM AOR seem particularly complicated, with different models and projection scenarios showing wide variation. This could be a result of having better data for North America, as descriptions of how various climate dynamics will interact (e.g., how precipitation, evaporation, temperature change and El Niño effects will combine) seem to contain greater detail than for many other regions. Whatever its cause, climate projections for the NORTHCOM AOR seem to spark greater debate within the science community than other regions. For example:

- "Projections of El Niño-La Niña frequency and intensity remain a challenge for even the best climate models, and projecting how changes in either might influence fires in Southern California or climate hazards linked to El Niño-La Niña is highly uncertain."
- "Amid much discussion and controversy, there is a growing consensus that future hurricanes will be more intense with higher peak wind speeds and more heavy precipitation. There is little or no consensus on whether the frequency of hurricanes will increase."⁶⁶

NORTHCOM's role in responding to these challenges is still taking shape. NORTHCOM operations have continued to evolve since its founding a little more than one year after the September 11, 2001 attacks. NORTHCOM provides "assistance in support of civil authorities

during natural and man-made disasters and pandemic events” when directed by either the secretary of defense or the president. NORTHCOM is unique among the regional combatant commands in that its operations within its AOR are constrained by the provisions of the Posse Comitatus Act in Title 18, U.S. Code. Given its atypical *raison d’être* and the current state of climate projections for its AOR, it is reasonable that NORTHCOM is focusing much attention on observed climatic changes as much as future projections. These are most prominent in the Arctic, where current observed changes in weather patterns are providing a sufficient level of information against which to plan.

Many NORTHCOM officials expect to see more areas with ice-free summers along a 20- to 40-year timeframe, based on the average of projections publicly available. This has important implications for NORTHCOM’s planning for its homeland defense roles. NORTHCOM must be prepared for the possibility that an opening Arctic may create a new route to enter U.S. territory for illicit transport interdiction and nonproliferation. Improving domain awareness and Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) will be important tasks given that these capabilities can be ineffective at high latitudes, and their command and control structure will need to comply with a range of treaties and constraints.

The effects of environmental change are also raising tough questions. Specifically, pollution and oil spills that could affect the territories of multiple countries will be a heightened concern as new areas are accessed for energy and minerals exploration. Migrating resources are also a growing concern, specifically the fish stocks that account for around 2 billion dollars in exports for Alaska.⁶⁷ Changing ocean

U.S. Northern Command Quick Facts (NORTHCOM)

- **Headquarters in Colorado Springs, Colo.**
- **Co-located with the North American Aerospace Defense Command (NORAD), which monitors and controls the airspace over the United States and Canada.**
- **AOR includes the continental United States, Alaska, Canada, Mexico and the surrounding water out to approximately 500 nautical miles. It also includes the Gulf of Mexico, the Straits of Florida and portions of the Caribbean region to include The Bahamas, Puerto Rico, and the U.S. Virgin Islands.**
- **The commander of USNORTHCOM is responsible for theater security cooperation with Canada, Mexico and The Bahamas.**

conditions are altering where fish are breeding and moving, which in turn can lead fishers from various countries into the EEZs of other countries, creating new concerns for managing U.S. territory. For example, according to a report by the USGCRP, “As air and water temperatures rise, marine species are moving northward, affecting fisheries, ecosystems, and coastal communities that depend on the food source.”⁶⁸ According to the report, observed fish stocks near Alaska moved, on average, 19 miles north of their original habitat between 1982 and 2006, sometimes moving outside America’s EEZ. “We

think, depending on the year and conditions, that roughly 10 to 20% of the [Alaskan fish] stock goes over to the Russian side,” one National Marine Fisheries Service scientist told *The Los Angeles Times*.⁶⁹

In the United States, coastal port communities could be particularly affected by sea level rise. In fact, if observed trends continue unabated, more than 12.5 million people and 9 trillion dollars in assets could be at risk of sea level rise by 2070. Of the most at risk areas, major port cities such as Baltimore; Boston; Los Angeles; Miami; New Orleans; New York-Newark; Providence, R.I.; Tampa Bay-St. Petersburg, Fla.; and Virginia Beach, Va. are likely to be affected the worst. Today’s observations suggest that approximately 6.1 million people in these communities are at risk from sea level rise. That number is projected to nearly double to 11.8 million at risk from sea level rise. Meanwhile, Canada will experience similar effects, with 6.5 million people and 337.8 million dollars in assets that could be vulnerable to rising sea level by 2070.⁷⁰

Several effects of climate change are likely in NORTHCOM’s AOR. Mexico’s most vulnerable area is the center of the country, with major increases in population growth and decreasing water supplies already affecting Mexico City and surrounding areas. Its Tabasco coast is highly vulnerable to sea level rise with the prospect of dramatic inland sea penetration.⁷¹ While states within NORTHCOM’s AOR are considered “stable” on the Failed States Index, Mexico is categorized as “borderline.” According to the index, “[c]orruption and lack of transparency continue within the government. Drug cartels and organized crime are also on the rise and hundreds of police, soldiers and prosecutors have been killed.”⁷² These trends appear to exacerbate the government’s illegitimacy, including its inability to provide security and social services. And given the recent spate of incidents associated with

Mexico’s endemic drug cartels and the declining oil production, which accounts for 40 percent of the government’s revenue, it is possible that the next iteration of the Failed States Index could rank Mexico as “in danger” of state failure.

Recommendation for NORTHCOM:

NORTHCOM possesses a well-developed understanding of how climate change directly affects interests in the Arctic. It should place the same emphasis on understanding the potential impacts of climate change in Mexico and its interests in the Caribbean. The Caribbean and several areas of Mexico have witnessed decreasing rainfall in recent decades, a trend that projections indicate will continue. Water scarcity and a rapidly increasing population can present many security challenges that will affect Mexico’s ability to deal with an increasingly difficult security situation in the country and along the border with the United States. This and other changes in the climate have the potential to alter agricultural output by geographical region, which could drive up food prices, among other effects. The Caribbean islands are vulnerable to sea level rise and extreme weather events, and coral reefs in the region that drive an estimated 3.1 billion dollars to 4.6 billion dollars in tourism could suffer.⁷³ NORTHCOM’s success in managing future climate change effects will require a stronger recognition of changes in its AOR beyond just the Arctic.

RECOMMENDATIONS

Several observations emerged through the course of our research and meetings with representatives of the unified combatant commands.

Improve Stewardship of the Arctic. The United States must clearly define its own roles and responsibilities in governance, diplomacy and security. We make the following three recommendations for that purpose.

Ratify the U.N. Convention on the Law of the Sea. Ratifying UNCLOS is perhaps the most important next policy step in ensuring that the United States and DOD are prepared to adapt to a changing climate and realize the opportunities that climate change may enable. As the participants in the 2008 Arctic Oceans Conference in Ilulissat, Greenland declared, UNCLOS is the international “legal framework to the orderly settlement of any possible overlapping claims” in the Arctic Ocean.⁷⁴ UNCLOS provides effective processes for delineation of the limits of the extended continental shelf, and delineates the freedom of navigation rules that the United States abides to today. Without ratification of UNCLOS, the United States will not have a seat at the table as recommendations are made regarding continental shelf claims in the Arctic.

Participate in the Arctic Council. At the national level, the United States must continue to use the Arctic Council as a forum for adjudicating grievances and conflicts, given that the Arctic Council is the only formal body outside of UNCLOS charged with facilitating cooperation, coordination and engagement between Arctic member states over development and environmental issues in the region. What is more, even with the ratification of UNCLOS, the United States would be able to use the Arctic Council to sustain engagement

with its Arctic neighbors and to adjudicate immediate issues, such as coordinating short-term crises that may develop and require an immediate response (e.g., search and rescue operations).

Establish NORTHCOM as the supported commander in the Arctic region. United States territorial waters and the resources within its EEZ already lie within NORTHCOM’s AOR. Also, given that NORTHCOM already coordinates closely with Canada over a number of combined operations such as theatre security cooperation, countering weapons of mass destruction and narcotics trafficking, aerospace control and maritime warning, the command has a unique and well-developed working relationship with Canada that would help navigate issues over Arctic cooperation while insulating it from political conflicts with other states (e.g., Russia) that fall outside its AOR. NORTHCOM’s unique role in governance of its AOR (versus roles that are primarily offensive in nature) could indicate that its expertise is better suited for command and control in the Arctic than EUCOM or PACOM. While it is unclear how the process of creating a comprehensive framework for the Arctic will play out, it is clear that it will take time to explore policy options, and require unity of effort from DOD. Finally, a civilian-led command akin to NORTHCOM would help to unify diplomatic, development and public engagement efforts with other Arctic states’ civilian agencies.⁷⁵

Beyond the Arctic, the effects of climate change require further adjustments from all of the combatant commands as well. While each combatant commander’s AOR and missions are unique, there are likely to be common challenges to better incorporating climate science into their work. The following recommendations may facilitate

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the integration of climate change analysis into the commander's decision making processes.

Develop Climate Expertise in the COCOMs:

Respecting the combatant commanders' roles in organizing their staffs, we recommend that combatant commanders each designate an action officer for addressing climate change impacts in planning and operations. Upon studying each combatant command, we feel the best location for this expertise is within the Strategy and Plans (J5) directorate, but most planning scenarios will require assistance and coordination from most, if not all, of the other directorates and command level staff.

In the course of our research, we observed that, across the combatant commands, there is no single point of contact within each staff for issues related to climate change, and that in some cases there is no person dedicated to look at these issues. Because climate change affects each combatant commander's AOR differently and because staff organizations are tailored to each commander's needs, there is no well-defined directorate in which to place staff knowledgeable about climate change. Directorates from logistics to resources to strategy and plans to the interagency may all

have a need to address the secondary and tertiary impacts of climate change in the course of their work. During the staffing process for developing and reviewing the QDR, the points of contact for climate change issues could be found in any one or more of the directorates, most likely at the discretion of the staff's secretariat, who decides which directorate to assign formal tasks. When not well-defined, the decision of where in the staff to assign such formal staff tasking, or even whether this expertise is necessary, depends on the combatant commander's mission and operational environment.

Access the Best Climate Science. We recommend that as often as possible, combatant command staff officers who need specific climate projections or information should seek answers from the climate science community. These relationships are important to accurately assess risks and avoid wrong information. And even where single sources of information provide the best data available, representatives from the climate science community can identify these best sources rather than leaving that responsibility up to DOD personnel.

In our conversations with field-grade staff officers, we observed that staff officers most often received their initial information about climate change for planning purposes from the U.S. Joint Forces Command's Joint Operating Environment (JOE) document series. The JOE serves to sketch the future strategic environment and anticipate possible threats and challenges that unified combatant commanders may face. Some of the more enterprising staff officers we spoke with used the JOE as a starting point for discussion and research and additionally looked to a myriad of other sources for scientific data and regional observations on climate change. Their drive to seek out better data, however, did not stem from the need to understand climate change in and of itself, but rather to use the data for informing a

specific theater-level mission planning initiative, scenario or decision.⁷⁶

No single source of information will ever suffice to cover what any given combatant commander needs to know about climate change. It is a global challenge that touches upon almost all aspects of security in some way. Furthermore, it involves the full range of strategic, operational and tactical issues. No matter how good their content – or their critical importance in setting priorities for the DOD – documents like the QDR and the JOE should never be treated as primary sources for all climate change information. Global assessments such as the Intergovernmental Panel on Climate Change’s assessment reports and information provided by the USGCRP provide decent basic climate understanding. Depending on the region in question, sources from the World Bank, USAID, nongovernmental organizations or other groups can often provide useful local-level observations on how climatic changes are affecting specific communities. Science journals and reports from the National Academies of Science and Engineering are often useful as well. Finally, a forthcoming Naval Studies Board assessment will offer detailed assessments of how the DOD is prepared to accommodate a range of likely climate change effects.

In addition to the challenges involved with finding the best information for the types of decisions the combatant commanders need to make, we observed that in almost all cases, understanding, addressing and adapting to climate change impacts and energy security challenges requires an interagency approach. Analysts often point to PACOM as a test bed for examining hurdles to operational energy challenges and for systems-level alternative energy integration, due to its unique energy and environmental challenges and its location so far away from the mainland.⁷⁷ While we concur

with that assessment, the most important lessons from PACOM with regard to DOD addressing climate change could involve its structured and well-coordinated efforts to work with other federal agencies and state and local groups to meet energy and climate goals. Indeed, the QDR states that the kind of interagency cooperation exhibited at PACOM will be vital for addressing climate and energy issues for the department.

However, while these all serve as good information sources, they are still static. Collaboration between security officials and climate scientists offers one of the most helpful methods of researching this problem, as scientists can then work to provide the most helpful information and generate new observations that can be more tailored.

Share Best Practices and Measure Success. We recommend that the combatant commanders leverage already-established ad hoc, casual or formal organizations that examine energy or environmental challenges, such as the Hawaii Clean Energy Initiative in Hawaii, as a forum for sharing best practices on meeting energy and climate requirements and goals. The Department of Defense (and potentially DOE or the White House Office of Energy and Climate Change Policy) should also aggregate these best practices at the federal level.

Many installations we visited while meeting with combatant command representatives are also beginning to experience some of the challenges and opportunities that the DOD faces regarding quantifying greenhouse gas emissions reductions. While touring a new Army base housing development in Hawaii, for example, we witnessed electricity metering equipment that calculated and stated the greenhouse gas emissions commensurate with the electricity being used at that home. Aggregating this kind of information consistently across the country and

across the military services is an important key to system-level planning, and the combatant commands offer a way for cross-service coordination to occur organically, particularly if the proper structures are in place for doing so. As the military components of several combatant commands are making progress on energy and climate measures, they are overcoming hurdles and developing best practices that would likely be useful information for other military installations. Maximizing effective use of contracting authorities and combining funding streams in order to invest in new energy technologies can take detailed knowledge and great effort. And even with the installation of clean energy technology, system-level questions can remain. For example, the hydrogen and E85 vehicles at Hickam Air Force Base in Hawaii would require more fueling infrastructure and fuel in order to increase their use. Steep challenges can also remain in integrating transport, residential and other energy use into a single, functioning system – especially in locations that suffer from fragile electric grids.

CONCLUSION

The combatant commands have a unique role in analyzing how climate change will affect the DOD and responding to these challenges. While much of the expertise on climate change resides within civilian agencies of government, understanding how climate change can combine with other factors to influence trends or ignite conflicts within each AOR will be important to the combatant commander's success in achieving assigned objectives. Addressing climate change challenges can also be leveraged for building confidence and partnerships among countries that share common interests in any AOR. For example, one PACOM official noted that many Navy and PACOM successes in furthering cooperation with Southeast Asian countries have stemmed from partnering with them on science

and technology development, such as tsunami early warning systems.

Given the likely effects of climate change in each of their AORs, better assessing and planning for projected effects will also bolster their long-term abilities to meet their responsibilities around the world. A thorough analysis of climate change effects in each AOR and how these effects impact the populations within the AOR can help the combatant commander develop better long-term theater level plans. This is not, however, simply a question of deciding to include climate change analysis in planning. It is a matter of educating planners to see the links between climate science and current and future threats. As we see in several locations around the globe, climate change already distinctly impacts the operating environment and affects the security environment. Their positions on the front lines of promoting and defending U.S. interests globally likewise puts each combatant command on the front line of confronting the challenges of climate change. Defining the Climate Change Challenge.

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