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Risk Report

THE IMPACT OF CLIMATE CHANGE ON THE U.S. MILITARY AND THE DEFENSE INDUSTRY

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THE IMPACT OF CLIMATE CHANGE ON THE U.S. MILITARY AND THE DEFENSE INDUSTRY

RISK REPORT

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Summary

The impact of climate change on the U.S. military and the defense industry is manifold, ranging from geopolitical and humanitarian aspects to facility, force, and equipment planning. Major climate threats with an immediate effect on the U.S. military include storms, flooding, drought, desertification, wildfires, and thawing permafrost. Another vital factor is the energy consumption of the U.S. armed forces, the world's leading military. High energy demands play a complicated role in risk emergence and risk mitigation. The Department of Defense has recognized these threats, however an efficient cooperation with state leadership is necessary to evade risks. The anticipated effects of climate change may prove to be both a challenge and an opportunity for the defense industry.

List of Abbreviations:

CO₂e	Carbon dioxide equivalent
DoD	United States Department of Defense
GAO	United States Government Accountability Office
kt	kilotons
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
OHDACA	Overseas Humanitarian, Disaster, and Civic Aid
SLVAS	Screening Level Vulnerability Assessment Survey
U.S.	United States
USAID	United States Agency for International Development

BOLTS: STRATEGIC, OPERATIONAL, FINANCIAL.

TAGS: CLIMATE CHANGE, CLIMATE RISKS, U.S. MILITARY, DEFENSE, CO₂ EMISSIONS, ENERGY, NATURAL GAS AND OIL, U.S. DEPARTMENT OF DEFENSE, U.S. ADMINISTRATIONS, GEOPOLITICS, HUMANITARIAN ASSISTANCE, INFRASTRUCTURE, FLOOD, DROUGHT, WILDFIRE, DESERTIFICATION, THAWING PERMAFROST.

Table of Contents

Introduction: Climate Change and National Security	8
The Administration of U.S. President Trump	10
The United States Department of Defense	10
Energy Demands of the U.S. Military as Perpetuating Force Behind Climate Change....	12
Disaster Relief and Humanitarian Implications	13
Geopolitical Impact	15
The Impact of Climate Change on Aerospace	16
The Impact of Climate Change on Military Facilities, Personnel, and Equipment	17
Storms and Flooding	19
Drought, Desertification, and Wildfires	20
Thawing Permafrost	21
Conclusion	22
Recommendations	22

Introduction: Climate Change and National Security

In 2017, the United States Congress stated in the annual defense policy bill that “climate change is a direct threat to the national security of the United States and is impacting stability in areas of the world both where the United States Armed Forces are operating today, and where strategic implications for future conflict exists.”¹ As greenhouse gases are emitted throughout the world, climate change accelerates, having severe effects on various aspects of life. Climate change not only affects the agriculture and energy industries but also military and defense capabilities around the globe.

The United States is particularly exposed to these risks, since it is home to the largest military in the world, according to data from 2019.² Climate change will put stress on the U.S. military in several ways. Since the publication of the Department of Defense’s (DoD) *Quadrennial Defense Review of 2014*, climate change is often referred to as a “threat multiplier” that exacerbates already existent global issues such as “poverty, environmental degradation, political instability, and social tensions.”³ It will imperil essential resources and resource regimes, become a catalyst for conflict, and slow down military preparedness and readiness as demand for military action grows.⁴

The security and prosperity of states is likely to come under threat by climate change and will command increased international attention. Climate-induced migration will put greater strain on border control regulations of states. International disaster relief and humanitarian action will also gain greater relevance. Governments and private businesses around the world have started green,

¹ **National Defense Authorization Act for Fiscal Year 2018, Amendment to H.R. 2810, 115th Cong. 2017.**

Available at:

https://langevin.house.gov/sites/langevin.house.gov/files/documents/LANGEVIN_CLIMATE_CHANGE_AMENDMENT.pdf (Accessed: July 4, 2019).

² **Global Firepower (2019): 2019 Military Strength Ranking.** Available at:

<https://www.globalfirepower.com/countries-listing.asp> (Accessed: July 4, 2019).

³ **U.S. Department of Defense (2014): Quadrennial Defense Review 2014.** Available at:

https://archive.defense.gov/pubs/2014_quadrennial_defense_review.pdf (Accessed: July 4, 2019).

⁴ **Fleishman, R. & Goodman, S. (2018): Climate change and the U.S. Military, American Foreign Policy Council Defense Dossier, 23(December 2018), pp.3-7.**

renewable energy initiatives to reduce greenhouse gas emissions and their effects on nature and weather conditions.

The impact of climate change and increased air temperatures can be observed in rising sea levels, melting glaciers, decreasing Arctic and Antarctic ice coverage, and greater rainfall variability. Warmer oceans also cause more frequent and intense storms, which result in destruction and flooding. Rising sea levels and coastal erosion is an additional threat to littoral regions. In 2018, the average temperature of the ocean surface was 1.19° Fahrenheit (0.66° Celsius) above the 20th century average and the fourth highest annual average temperature ever recorded by the National Oceanic and Atmospheric Administration (NOAA).⁵ At the current rate, Arctic sea ice is decreasing at 12.8% per decade, according to data by the National Aeronautics and Space Administration (NASA).⁶

The symptoms of global warming will alter the availability of resources and influence the dynamics between states and people. Insufficient access to water, fisheries, and agricultural products could incite conflict as these resources become increasingly scarce. Natural disasters will lead to the loss of human life, homes, and financial assets. Rebuilding infrastructure and buildings will result in additional financial burden. Preventive measures to protect against storms, floods, or wildfires may be taken, but they also require financial investment. This can be a risk for governments but also an opportunity for businesses specializing in robust, innovative construction and safety equipment. The adaptation of military equipment and facilities for changing climate conditions is a major concern for the U.S. Department of Defense.

This risk report will highlight central areas related to the U.S. military and defense industry that are affected by climate change. The report includes the role of energy consumption; international military operations and geopolitics; and the impact of climate change on aviation, military technology, facilities, and construction planning.

⁵ **National Oceanic and Atmospheric Administration (2018): *Global Climate Report: Annual 2018*. Available at: <https://www.ncdc.noaa.gov/sotc/global/201813> (Accessed: July 5, 2019).**

⁶ **National Aeronautics and Space Administration (2019): *Arctic sea ice minimum*. Available at: <https://climate.nasa.gov/vital-signs/arctic-sea-ice/> (Accessed: July 5, 2019).**

The Administration of U.S. President Trump

While the effects of climate change on the U.S. military were regarded as a top priority under the administration of President Barack Obama (2008-2017), climate-related concerns have received reduced attention under the administration of incumbent President Donald Trump (2017-present). At the beginning of his term in office, President Trump revoked a memorandum signed by President Obama in 2016, according to which the U.S. DoD had to factor in climate change when planning and constructing new facilities. Under the Trump administration, climate change was also eliminated as a threat from the National Security Strategy in 2017.⁷ The change in position was cemented by Trump's withdrawal from the landmark 2016 Paris Agreement on climate change after stating that the treaty imposes unfair restraints on the United States.⁸ The U.S. House of Representatives resisted Trump's attempt to withdraw by passing a legislation in May 2019 that would allow the U.S. to remain a signatory state of the Paris Agreement.⁹ It remains to be seen whether Trump will be successful in his effort to depart from the agreement towards the end of 2019.

The United States Department of Defense

As early as 2010, the Pentagon recognized climate change as a serious risk to military operations and installations. During Obama's presidency, the DoD released the *2014 Climate Change Adaption Roadmap*, which offered guidelines to adapt military training and testing, plans and operations, built and natural infrastructures, and acquisition and supply chains to the challenges of climate change. The roadmap acknowledges that "[t]he impacts of climate change may cause instability in

⁷ Capaccio, T. et al. (2019): Defense department warns about climate change impacts to armed forces and bases, *Time*. Available at: <https://time.com/5507465/climate-change-impact-armed-forces-bases/> (Accessed: July 3, 2019).

⁸ Duke, R. (2019): Leaving the Paris Agreement Is a Bad Deal for the United States, *Foreign Policy*. Available at: <https://foreignpolicy.com/2019/05/19/leaving-the-paris-agreement-is-a-bad-deal-for-the-united-states/> (Accessed: July 4, 2019).

⁹ Duke, R. (2019): Leaving the Paris Agreement Is a Bad Deal for the United States, *Foreign Policy*. Available at: <https://foreignpolicy.com/2019/05/19/leaving-the-paris-agreement-is-a-bad-deal-for-the-united-states/> (Accessed: July 4, 2019).

other countries by impairing access to food and water, damaging infrastructure, spreading disease, uprooting and displacing large numbers of people, compelling mass migration, interrupting commercial activity, or restricting electricity availability.”¹⁰ The DoD highlights the following factors which pose the greatest risks to its activities:¹¹

- Rising global temperatures
- Changing precipitation patterns
- Increasing occurrence and intensity of extreme weather conditions
- Rising sea levels and associated storm surge

Mandated by the Congress, the DoD published the *Report on Effects of a Changing Climate to the Department of Defense* in January 2019, further investigating the impact of climate change on the military. The department identified 79 domestic installations in United States that were most highly exposed to climate change risks, including recurrent flooding, drought, desertification, wildfires, and thawing permafrost. The following numbers indicate the distribution of these 79 domestic installations among the various military branches:¹²

- | | |
|--|------------------|
| • Air Force | 36 installations |
| • Army | 21 installations |
| • Navy | 18 installations |
| • Defense Logistics Agency | 2 installations |
| • Defense Financing and Accounting Service | 1 installation |
| • Washington Headquarters Service | 1 installation |

The report helps to identify major threats to the U.S. military, but its scope is limited as it omits international facilities and the installations of the Marine Corps. Despite these shortcomings, the DoD’s awareness of climate change as major risk contrasts the stance of President Trump. Therefore, the DoD could face the challenge of receiving insufficient recognition from the state leadership in the implementation of climate-related projects.

¹⁰ U.S. Department of Defense (2014): *2014 Climate Change Adaption Roadmap*. Available at: https://www.acq.osd.mil/eie/downloads/CCARprint_wForward_e.pdf (Accessed: July 4, 2019).

¹¹ Ibid.

¹² U.S. Department of Defense (2019): *Report on Effects of a Changing Climate to the Department of Defense, January 2019*. Available at: <https://media.defense.gov/2019/Jan/29/2002084200/-1/-1/1/CLIMATE-CHANGE-REPORT-2019.PDF> (Accessed: July 4, 2019).

Energy Demands of the U.S. Military as Perpetuating Force Behind Climate Change

While the military will presumably have to manage the consequences of climate change in the future, it also significantly contributes to climate change. The U.S. military consumes vast amounts of air-polluting fuel, superseding the carbon dioxide equivalent (CO₂e) emission levels of a large number of countries in the world.

The U.S. armed forces are the single biggest petroleum buyer in the world, investing an annual average of USD 14.28 billion into the purchase of natural oil between 2007 and 2015.¹³ According to a study from 2019, the U.S. military would be the 49th largest emitter of greenhouse gases in the world in terms of fuel usage if it were a state, ranking between Peru and Portugal.¹⁴ The research paper states that in 2017, the U.S. military acquired roughly 270,000 barrels of oil per day and produced about 25,000 kilotons (kt) of CO₂e. Among the four military branches, the Air Force alone bought USD 4.9 billion worth of fuel and generated the most greenhouse gas emissions, accounting for 13,000 kt of CO₂e. The Navy acquired USD 2.8 billion worth of fuel and emitted 7,800 kt of CO₂e. The U.S. Army and the Marines required significantly less energy, purchasing USD 947 million and USD 36 million worth of fuel, respectively and accordingly, emitted less greenhouse gases. The Army produced 2,200 kt of CO₂e while the Marines generated only 110 kt of CO₂e.¹⁵

The dependence of the U.S. armed forces on a vast quantity of energy to operate aircrafts and battleships creates problematic consequences for the climate and energy policies of the United States in the long-term. The position of the United States regarding climate change, therefore, is complex. The DoD acknowledges the complications of climate change and its impact on the military, but it also contributes to climate issues. This explains why the topic has gained substantial

¹³ Gardner, T. (2017): U.S. military marches forward on green energy, despite Trump, *Reuters*. Available at: <https://www.reuters.com/article/us-usa-military-green-energy-insight/u-s-military-marches-forward-on-green-energy-despite-trump-idUSKBN1683BL> (Accessed: July 4, 2019).

¹⁴ Belcher, O. et al. (2019): Hidden carbon costs of the 'everywhere war': Logistics, geopolitical ecology, and the carbon boot-print of the US military. *Transactions of the Institute of British Geographers* 2019, pp.1-16.

¹⁵ Ibid.

relevance as candidates campaign in the run-up to the U.S. presidential election, which will take place on November 3, 2020.¹⁶

By adopting renewable energy programs, the U.S. military can contribute to mitigating climate risks for its operations and facilities. Steps in this direction have already been taken as early as 2007 when the *National Defense Authorization Act* set a goal for the DoD to acquire and produce a minimum of 25% of its electric power from renewable energy sources by 2025.¹⁷ Another step towards renewable energy consumption was made in 2014 when the U.S. Army Office of Energy Initiatives was established to implement green and alternative energy projects for the Army. The number of renewable energy initiatives of the U.S. military had almost tripled to 1,390 between 2011 and 2015, with domestic military bases focusing particularly on green energy projects to strengthen self-sufficiency and security in times of crisis.¹⁸ At the same time, the natural oil consumption of the military decreased by 20% between 2007 and 2015. The cause of this development, however, may lie in a decreased number of combat operations rather than a replacement of fossil fuels with renewable energy.¹⁹ A decreased use of petroleum impacts businesses such as ExxonMobil, BP, or Shell, which supply the military with fossil fuels. If the military manages to accelerate green energy policies, renewable energy contractors like solar power companies will reap benefits while traditional fuel suppliers are likely to observe a decrease in profits.

Disaster Relief and Humanitarian Implications

The United States Agency for International Development (USAID) manages disaster relief and humanitarian aid operations by the U.S. military. If the frequency and magnitude of natural disasters

¹⁶ See McKibben, B. (2019): *Climate change suddenly matters in the 2020 race: Are the candidates ready?*, *Politico*. Available at: <https://www.politico.com/magazine/story/2019/05/07/climate-change-election-2020-226797> (Accessed: July 4, 2019).

¹⁷ *National Defense Authorization Act for Fiscal Year 2007*, H.R. 5122, 109th Cong. 2005-2006. Available at: <https://www.congress.gov/bill/109th-congress/house-bill/5122> (Accessed: July 5, 2019).

¹⁸ Gardner, T. (2017): *U.S. military marches forward on green energy, despite Trump*, *Reuters*. Available at: <https://www.reuters.com/article/us-usa-military-green-energy-insight/u-s-military-marches-forward-on-green-energy-despite-trump-idUSKBN1683BL> (Accessed: July 4, 2019).

¹⁹ *Ibid.*

around the world increases, the U.S. military will have to invest more resources into its disaster aid capacities including medical care, electricity access, water purification, and restoration of infrastructure.

After Typhoon Haiyan moved across Southeast Asia and devastated the Philippines in 2015, the DoD carried 5,640 victims to safety and sent 1,200 first responders and 750,000 pounds of supplies.²⁰ When Hurricane Sandy caused devastation in the United States in 2012, the DoD deployed 14,000 personnel to manage first aid relief and another 10,000 personnel to restore infrastructure and provide other services in the aftermath.²¹ Supplying relief domestically and internationally is likely to put increased strain on the DoD and the military if the climate situation further deteriorates. Disaster support will demand a greater financial budget, which is largely granted by the DoD Overseas Humanitarian, Disaster, and Civic Aid (OHDACA) appropriation for cases of emergencies in other countries.²² OHDACA-funded operations serve to mitigate risks of “human suffering, disease, hunger, and privation, particularly in regions where humanitarian needs may pose major challenges to stability, prosperity, and respect for universal human values.”²³

The cost of foreign humanitarian assistance was approximately USD 50 billion in the 2017 fiscal year, which amounts to 1.2% of the total federal budget.²⁴ This number includes not only humanitarian assistance, but also long-term development aid as well as military and security assistance. If climate change results in a growing demand for disaster aid and the government supports the provision of such aid, then budget expansions for humanitarian operations of the military must be anticipated in the future.

²⁰ La Shier, B. & Stanish, J. (2017): *Issue brief: The national security impacts of climate change, Environmental and Energy Study Institute*. Available at: <https://www.eesi.org/papers/view/issue-brief-the-national-security-impacts-of-climate-change> (Accessed: July 4, 2019).

²¹ *Ibid.*

²² *Ibid.*

²³ Defense Security Cooperation Agency (n.d.): *Overseas Humanitarian, Disaster, and Civic Aid (OHDACA)*. Available at: <https://www.samm.dsca.mil/chapter/chapter-12> (Accessed: July 4, 2019).

²⁴ Lawson, M. L. & Morgenstern, E. M. (2019): *Foreign aid: An introduction to U.S. programs and policy, Congressional Research Service*. Available at: <https://fas.org/sgp/crs/row/R40213.pdf> (Accessed: July 4, 2019).

Geopolitical Impact

An aggravated climate situation will put a strain on immigration channels and on vulnerable developing regions such as the Horn of Africa. Dwindling resources can lead to an increased risk of conflict when key resources such as clean water are weaponized. Water shortages, poor water quality, and floods are predicted to be a critical risk for North Africa, the Middle East, and South Asia by 2040.²⁵ This carries serious implications for deployed U.S. troops and foreign intervention operations. Resource shortages and regional instability could also produce a higher risk of mass migration. The European refugee crisis of 2015 illustrates to what extent mass migration can put pressure on regional politics.

While it is clear that rising temperatures result in the warming of the poles and the melting of Arctic and Antarctic ice, the risks and benefits of this development may not be apparent at first glance. Melting ice in the Arctic Ocean clears the path for a new strategic route between the U.S., Canada, Russia, and China. The DoD already identified risks associated with this new strategic pathway when it stated in the *2014 Climate Change Adaption Roadmap* that “[t]he opening of formerly-frozen Arctic sea lanes will increase the need for the Department to monitor events, safeguard freedom of navigation, and ensure stability in this resources-rich area.”²⁶ This means that the U.S. Navy will boost its resources and expand its area of responsibility to the far north.

While the melting of poles can facilitate sea traffic between the U.S. and the east, geopolitical tensions may rise as China extends its reach through the Polar Silk Road project and benefits from shorter shipping routes to the west. This is why China is investing in Arctic states such as Iceland and Greenland to expand its area of influence. Russia will profit from its long Arctic coastline and may be able to influence the traffic on shorter Arctic shipping routes. What may cause concern among U.S. military policymakers and strategists is that foreign ships from Russia or China, for instance, are likely to have facilitated access to North American shores. Geopolitical shifts resulting from climate change could therefore become a challenge for heads of state in numerous countries

²⁵ La Shier, B. & Stanish, J. (2017): **Issue brief: The national security impacts of climate change**, *Environmental and Energy Study Institute*. Available at: <https://www.eesi.org/papers/view/issue-brief-the-national-security-impacts-of-climate-change> (Accessed: July 4, 2019).

²⁶ U.S. Department of Defense (2014): *2014 Climate Change Adaption Roadmap*. Available at: https://www.acq.osd.mil/eie/downloads/CCARprint_wForward_e.pdf (Accessed: July 4, 2019).

that are deemed relatively safe. The role of the military would be vital in ensuring national security in times of geopolitical upheaval.

The Impact of Climate Change on Aerospace

The aviation industry particularly suffers from climate change as air currents shift and temperatures rise. The findings presented in this section shed light on the impact of climate change on military flight by referring to publicly available data on commercial aviation. While commercial and military aviation must not be confused, lessons can be drawn from information on commercial flights by the European air traffic safety organization, Eurocontrol. A number of findings demonstrate the severity of climate-induced challenges to aviation:²⁷

- **High temperatures** can impact aircraft performance and make it more difficult for aircrafts to take-off. Air density decreases as air temperature rises, reducing lift, which in turn requires more thrust and a longer runway to facilitate take-off. The weight of an airplane also impacts the ease with which it can lift off. This could be relevant for heavier military aircrafts carrying arms.
- **More frequent and intense storms and air currents** can make flight routes more difficult to navigate. Intense storms and changing wind patterns result in tumultuous and potentially less predictable flights. Air currents above the north Atlantic Ocean have become more powerful and may accelerate transatlantic flights. At the same time, changing air streams in this region increase the likelihood and frequency for aircraft to encounter clear-air turbulence. Eurocontrol also states that changing storm patters can increase the amount of fuel that is burned during flight, leading to higher costs.
- **Rising sea levels, tropical cyclones, or heavy rains** pose a threat to air bases and landing sites along the coast. Airport capacity, infrastructure, and access may be impaired. Communication may be impacted as well if networks are disrupted. If runways are flooded and airports devastated, aircraft will have to land at, or depart from, other landing sites.

Climate change can affect the performance and cost of military flights while climate conditions impact the availability and readiness of air bases and aircraft. Climate change can also pose challenges to Air Force pilots during flight. According to a vulnerability assessment report by the

²⁷ Eurocontrol (2019): *European Aviation Environmental Report 2019*. Available at: https://www.eurocontrol.int/sites/default/files/2019-06/eaer-2019_0.pdf (Accessed: July 3, 2019).

DoD from 2018, roughly 900 out of 1,531 Air Force sites suffered complications due to extreme temperatures, flooding, drought, wildfire, or storms.²⁸ Therefore, it is important to secure Air Force facilities and operations against climate change to facilitate the execution of missions and aerospace reconnaissance. Constructing seawalls can help to prevent the flooding of runways, for instance. It must be noted that the utilization of military drones may also be negatively affected by changing climate patterns. American defense and security corporation Lockheed Martin has already taken preventative measures. The F-35 Lighting II combat aircraft was tested in extreme climate conditions, including heat, cold, heavy snow, and heavy rain, to ensure its functionality even under extreme conditions.²⁹

The Impact of Climate Change on Military Facilities, Personnel, and Equipment

The real estate portfolio of the U.S. DoD is tremendous. The DoD possesses approximately 562,000 buildings and structures across 4,800 sites worldwide.³⁰ The entirety of the DoD's real estate assets are estimated to be worth USD 1.2 trillion.³¹ Considering the importance of the military for the United States and the expansiveness of the DoD's assets worldwide, it is imperative to ensure that there are no disruptions in arms and equipment supply chains, even if climate change aggravates the situation and resources diminish.

²⁸ U.S. Department of Defense (2018): *Climate-Related Risk to DoD Infrastructure Initial Vulnerability Assessment Survey (SLVAS) Report*. Available at: <https://climateandsecurity.files.wordpress.com/2018/01/tab-b-slvas-report-1-24-2018.pdf> (Accessed: July 5, 2019).

²⁹ Lockheed Martin (2015): *How it works: F-35 climatic testing*. Available at: <https://www.f35.com/in-depth/detail/how-it-works-f-35-climatic-testing> (Accessed: July 5, 2019).

³⁰ La Shier, B. & Stanish, J. (2017): *Issue brief: The national security impacts of climate change, Environmental and Energy Study Institute*. Available at: <https://www.eesi.org/papers/view/issue-brief-the-national-security-impacts-of-climate-change> (Accessed: July 4, 2019).

³¹ U.S. Government Accountability Office (2019): *Climate resilience: DoD needs to assess risk and provide guidance on use of climate projections in installation master plans and facilities designs*. Available at: <https://www.gao.gov/products/GAO-19-453> (Accessed: July 3, 2019).

In January 2018, the DoD released the *Climate-Related Risk to DoD Infrastructure Initial Vulnerability Assessment Survey: Screening Level Vulnerability Assessment Survey (SLVAS) Report*, for which the DoD investigated more than 3,500 of its facilities and installations worldwide. The findings of the report show that approximately half of these sites experienced the effects of climate change in the form of drought (782 cases), wind (763 cases), non-storm surge related flooding (706 cases), extreme temperatures (351 cases), flooding due to storm surge (225 cases), and wildfire (210 cases).³²

In 2019, the U.S. Government Accountability Office (GAO) also assessed 23 domestic military facilities and found that 15 had started adopting recommendations made by the DoD to avert climate-related risks. The eight remaining investigated facilities had not yet planned for the threats of climate change.³³ Improving the security of military bases, ports, and water and energy networks are essential countermeasures, but such projects are expected to cost billions of dollars.³⁴

As of 2019, the U.S. military employs 1.3 million active duty personnel and 860,000 reserve personnel.³⁵ Their ability to efficiently carry out tasks depends on the safety of the military facility. If floods or wildfires imperil staff, resulting evacuation and facility restoration can delay operations. Unfavorable climate conditions can also hinder staff from conducting military training, reconnaissance, or missions.

³² U.S. Department of Defense (2018): *Climate-Related Risk to DoD Infrastructure Initial Vulnerability Assessment Survey (SLVAS) Report*. Available at: <https://climateandsecurity.files.wordpress.com/2018/01/tab-b-slvas-report-1-24-2018.pdf> (Accessed: July 5, 2019).

³³ U.S. Government Accountability Office (2019): *Climate resilience: DoD needs to assess risk and provide guidance on use of climate projections in installation master plans and facilities designs*. Available at: <https://www.gao.gov/products/GAO-19-453> (Accessed: July 3, 2019).

³⁴ Fleishman, R. & Goodman, S. (2018): *Climate change and the U.S. Military, American Foreign Policy Council Defense Dossier*, 23(December 2018), pp.3-7.

³⁵ Global Firepower (2019): *United States military strength*. Available at: https://www.globalfirepower.com/country-military-strength-detail.asp?country_id=united-states-of-america (Accessed: July 4, 2019).

Storms and Flooding

Coastal and riverine flooding creates vulnerabilities for military bases and installations. Flooding can be caused by extreme weather conditions such as storms or high tides. The U.S. east coast and Hawaii are especially vulnerable to coastal flooding. Sea level rise and flooding also pose a particularly high risk to the Navy Region Mid-Atlantic and the greater Hampton Roads area in Virginia, where U.S. military sites are densely agglomerated.³⁶ The 2014 Pentagon report estimates that the ocean level will rise 1.5 feet in the course of the next 20 to 50 years in this region.³⁷

“Sunny day” flooding, which occurs during high tide, is also a notable risk for bases set up near shores. The DoD reports that recurrent “sunny day” flooding already negatively impacts numerous coastal communities. 14 inches of sea level rise since 1930 at Joint Base Langley-Eustis in Virginia have led to increasingly severe flooding of the military installation.³⁸

Military camps that experienced damages from hurricanes include the U.S. Air Force Base Tyndall in Florida, the Marine Corps’ Camp Lejeune in North Carolina, and the Navy Base Coronado in California. Repairment costs can be high and disruption of operations can last long. Moreover, relocating arms and equipment during the recovery phase is a logistical challenge. When Hurricane Michael’s damaging 130 mph wind speeds impacted Air Force Base Tyndall in October 2018, reconstruction was costly and time consuming, requiring almost a month until full operation was resumed. Tyndall is of critical importance as it is home to the headquarters of the Florida Air National Guard; the 325th Fighter wing; a vital F-22 Raptor fighter jet force; and a major training and testing center for pilots, maintenance personnel, and equipment. Almost a third of the United States’ F-22 fleet was incapacitated during reconstruction and aircraft were transferred to several smaller regional airbases.³⁹ Similarly, Camp Lejeune suffered extensive damage when Hurricane Florence

³⁶ U.S. Department of Defense (2014): *2014 Climate Change Adaption Roadmap*. Available at: https://www.acq.osd.mil/eie/downloads/CCARprint_wForward_e.pdf (Accessed: July 4, 2019).

³⁷ Ibid.

³⁸ U.S. Department of Defense (2019): *Report on Effects of a Changing Climate to the Department of Defense, January 2019*. Available at: <https://media.defense.gov/2019/Jan/29/2002084200/-1/-1/1/CLIMATE-CHANGE-REPORT-2019.PDF> (Accessed: July 4, 2019).

³⁹ Myers Jaffe, A. (2019): *Climate change is a threat to military security, Council of Foreign Relations*. Available at: <https://www.cfr.org/blog/climate-change-threat-military-security> (Accessed: July 3, 2019).

rolled over the region in September 2018. Naval Base Coronado is particularly vulnerable to tropical storms and flash flooding in El Niño years when ocean and atmosphere temperatures deviate in the east-central Equatorial Pacific, warming the sea water during winter season and impacting the weather.⁴⁰ El Niño years occur irregularly every two to seven years.

Drought, Desertification, and Wildfires

The consequences of drought affect water supply and military staff. Water supply may shrink when dry periods impact regions reliant on surface water. Moreover, heat exhaustion or heat strokes can incapacitate personnel in warm and dry areas. The operation of cooling systems drive up energy consumption and expenditures. Drought can also rupture roads and landing strips, which then requires maintenance. The southwest of the United States is especially vulnerable to drought. DoD facilities in the Washington, D.C. area such as Joint Base Anacostia Bolling, Joint Base Andrews, the U.S. Naval Observatory/Naval Support Facility, and Washington Navy Yard have previously experienced droughts.⁴¹ Joint Base Andrews assumes a vital role in the military because it is known as the home base of Air Force One, which is responsible for the air travel of the U.S. President.

Desertification dries out vegetation and erodes the soil, leading to an excessive amount of sediment in water reservoirs and other areas. Rainfall in affected areas can lead to floods that are particularly difficult to manage. Desertification affects the practicability of military maneuvers, exercises, and testing. The DoD highlights that desertification is a central stressor for Camp Roberts in San Miguel in California and White Sands Missile Range in New Mexico.⁴²

Wildfire is another major concern for DoD installations. Fires can result in major financial and asset loss, logistical restructuring, and a delay of military activities. Droughts and winds can aggravate the

⁴⁰ U.S. Department of Defense (2019): *Report on Effects of a Changing Climate to the Department of Defense, January 2019*. Available at: <https://media.defense.gov/2019/Jan/29/2002084200/-1/-1/1/CLIMATE-CHANGE-REPORT-2019.PDF> (Accessed: July 4, 2019).

⁴¹ Ibid.

⁴² U.S. Department of Defense (2019): *Report on Effects of a Changing Climate to the Department of Defense, January 2019*. Available at: <https://media.defense.gov/2019/Jan/29/2002084200/-1/-1/1/CLIMATE-CHANGE-REPORT-2019.PDF> (Accessed: July 4, 2019).

devastation caused by wildfires. The timely evacuation of military personnel is imperative in the case of a wildfire. When a wildfire approached the Marines' Mountain Warfare Training Center close to the Sierra Nevada in September 2018, the facility had to be evacuated.⁴³ Similarly, the Vandenberg Air Force Base in southern California was also partially evacuated in November 2017 when a wildfire erupted in the vicinity.⁴⁴

Thawing Permafrost

Permafrost is a layer of the ground that remains frozen throughout the year at 32° Fahrenheit (0° Celsius) or below. Rising global temperatures result in the melting of permafrost which erodes the strength of soil. Infrastructure, military maneuvers, training, and testing may become unsafe on such weak ground. Military installations in Alaska are most affected since 85% of the state rests on permafrost. Permafrost is particularly thick in northern regions and gradually decreases towards the south. Calculating zones that are prone to thawing permafrost is of critical importance for military infrastructure planning and maintenance. The DoD identified Fort Greely in the Southeast Fairbanks Census Area in Alaska as most exposed to permafrost-related risks.⁴⁵ Fort Greely is important because it is an Army launch site for anti-ballistic missile defense. The site hosts missiles that can be utilized against potential intercontinental ballistic missile attacks from North Korea.⁴⁶

⁴³ Myers Jaffe, A. (2019): Climate change is a threat to military security, *Council of Foreign Relations*. Available at: <https://www.cfr.org/blog/climate-change-threat-military-security> (Accessed: July 3, 2019).

⁴⁴ U.S. Department of Defense (2019): *Report on Effects of a Changing Climate to the Department of Defense, January 2019*. Available at: <https://media.defense.gov/2019/Jan/29/2002084200/-1/-1/1/CLIMATE-CHANGE-REPORT-2019.PDF> (Accessed: July 4, 2019).

⁴⁵ U.S. Department of Defense (2019): *Report on Effects of a Changing Climate to the Department of Defense, January 2019*. Available at: <https://media.defense.gov/2019/Jan/29/2002084200/-1/-1/1/CLIMATE-CHANGE-REPORT-2019.PDF> (Accessed: July 4, 2019).

⁴⁶ See Bumiller, E. & Sanger, D. E. (2011): Gates warns of North Korea missile threat to U.S., *New York Times*. Available at: <https://www.nytimes.com/2011/01/12/world/asia/12military.html> (Accessed: July 4, 2019).

Conclusion

If heads of state do not work closely with energy and environment policymakers to address the issues of climate change, the U.S. military must anticipate serious challenges to the safety of its facilities and practicability of its operations at home and abroad. Areas affected by climate change are geopolitics, disaster relief and humanitarian assistance, military maneuvers, and the security of DoD facilities and personnel. While the DoD has recognized the impact of climate-related risks to its installations and activities, the current administration under President Trump appears to deny the significance of climate change. The effective cooperation between the state leadership and the DoD, however, are vital to guarding national defense from climate risks and associated losses of assets and time. While threats from Russia and China are conspicuous to policymakers and observers, the manifold consequences of climate change for the military may be less apparent. This opaqueness of climate risks in itself may be a major risk to unaware policymakers. The impact of climate change, however, is critical because it is immediate, continuous, and global. Therefore, it is imperative to not only adapt to changing climate conditions but also to address the root cause of the climate crisis, which is the emission of greenhouse gases.

Recommendations

Several selected recommendations could offer relief to the U.S. military and militaries of other countries. While these adaptations may require increased financial investment, they may result in enhanced long-term safety and operability. Businesses seeking to produce and develop climate-resistant equipment may be able to profit from the need for such products.

- Establishing a **research fund to systematically assess climate-related vulnerabilities**
- Mapping out **how climate change affects all global regions** in which the U.S. military operates in order to improve the planning and execution of maneuvers
- Determining **how climate change impacts equipment, gear, and arms**, and making contracts with businesses that provide equipment that is resistant and adaptive to extreme weather conditions
- Systematically installing **infrastructure and facility improvements**, including:
 - Sea walls and coastal protection
 - Catastrophe shelters

- Flood levees
- Water drainage, cleansing, and storage systems
- Regular road and runway maintenance
- Electricity safety and emergency power aggregates



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