EPICENTERS OF CLIMATE AND SECURITY: THE NEW GEOSTRATEGIC LANDSCAPE OF THE ANTHROPOCENE

June 2017

Edited by:
Caitlin E. Werrell and Francesco Femia

THE CENTER FOR CLIMATE AND SECURITY

Sponsored by:

skoll global threats fund

In partnership with:

Carnegie Mellon University
Civil and Environmental Engineering

SCHOOL OF GEOGRAPHY AND THE ENVIRONMENT
UNIVERSITY OF OXFORD

Energy Science Technology & Policy
Carnegie Mellon University
College of Engineering

ASP
American Security Project

Planetary Security INITIATIVE

Health and Climate Security: Interconnected Security Challenges of Climate change and Infectious Disease

Kaleem Hawa[1]

Introduction: When Climate Change, Global Health, and Security Intersect

From Zika to Ebola, and from avian flu and SARS before them, security agencies, military officers, and civilian policymakers have increasingly been forced to come to grips with the impact of health and disease on national security. A key turning point for this concept – when the HIV/AIDS epidemic was deemed a national security threat by the U.N. Security Council and the U.S. National Intelligence Council[2] – has since been followed by myriad policy and defense adjustments. The White House *National Security Strategy*, the U.S. Department of Defense (DoD) *National Military Strategy*, and the *Quadrennial Defense Review* have all cited the spread of pathogens and infectious disease as a major security concern.[3] The National Security Council employs a senior director for global health security and biodefense while the DoD employs an assistant secretary of defense for health affairs[4] as well as a deputy assistant secretary of defense for health readiness policy and oversight, whose remit includes "force health protection, national disaster support, medical research and development, […] and medical readiness for 2.3 million Service members."[5]

As another emergent security concern, climate change has also been increasingly integrated into military policy and planning.[6] It is perceived by U.S. national security leadership as a threat multiplier[7] and a "direct risk to U.S. military readiness, operations and strategy."[8] Policy and governance have followed suit, urging planners to view the geopolitical and socioeconomic instability linked to extreme weather as a security threat and to improve climate preparedness and resilience.[9]

It is where these two phenomena intersect that has been most interesting to watch, with the DoD's 2014 *Climate Change Adaptation Roadmap*[10] and the Congressional submission *National Security Implications of Climate-Related Risk and Changing Climate*[11] both citing global health and pandemics as potential security risks linked to climate change. And this intersection is having real-world implications for the United States right now: Climate augmentation has led Zika and other insect-transmitted diseases to be identified as areas of concern for 2017, especially in temperate Texas, Florida, and the U.S. Gulf Coast.[12]

It is clear, therefore, that policymakers must increasingly equip themselves to understand the complex ways climate change and health intersect and the implications this will have on security. This short paper will outline some of the milieus in which the three are already interacting and how they may collide in the future.

First, climate change may alter disease trends of vector-borne illnesses in ways that directly affect the health of defense forces. Second, as climate change contributes to changing patterns of natural disasters and extreme weather events, disease transmission may be augmented. Third, climate interactions may drive conflict and refugee migratory dynamics, increasing health risks for U.S. humanitarian assistance and disaster relief personnel. Finally, serious pandemics and outbreaks hold the potential to be an existential threat, with outsized impacts on international order and, therefore, global security.

Intensifying the Risk: Climate Change, Vector-Borne Infection, and the Security Community

Promoting the health of defense forces has long been a core responsibility of the DoD and its counterparts in countries around the world. The DoD invests heavily in monitoring the health of at-home and deployed military personnel, tracks disease trends that may affect their global operations or readiness, develops medical countermeasures and diagnostics, and partners with civilian agencies to promote global health security. This is no small part of their remit either; with budget appropriations exceeding USD $579 million, the estimated global health expenditure by the DoD is larger than that of the Centers for Disease Control or National Institutes of Health in FY 2012.[13] Therefore, as the changing climate alters disease trends and conditions in a manner that influences public health, defense forces will continue to have emergent needs and interests in these developments.

One component of the DoD's health security investments that converges with climate change is vector-borne illnesses (VBIs). Transmitted by vectors such as mosquitoes, ticks, fleas, and sandflies, this class includes malaria, Dengue fever, and Zika, and accounts for more than 17% of all infectious diseases, causing more than 1 million

deaths annually.[14] The DoD has noticed – the Global Emerging Infections Surveillance and Response section of the Armed Forces Health Surveillance branch of the Military Health System partners with a variety of overseas laboratories to monitor the growth of VBIs as a threat in regions with active military deployment.[15]

To understand the VBI security risk in the context of burgeoning climate change, it is important to review the multiple factors that affect rates of transmission: the speed of vector reproduction, the frequency of vector interactions with humans, and the geospatial range of vector distribution.[16] In all three dimensions, climate disruption plays a role in intensifying the effects. Considering mosquitoes as a sample vector, evidence suggests that increases in temperature reduce extrinsic incubation periods, leading to faster mosquito maturation and proliferation[17]; in warmer climates, mosquitoes digest blood faster and feed more often, increasing transmission rates[18]; and increased precipitation patterns can expand the range of breeding sites for the mosquitoes, putting them in contact with more people.[19]

In this way, climate change becomes a force multiplier for global health risks. This is of unique concern to the DoD and other military organizations because, as a number of defense community health specialists articulated in a 2011 journal article, DoD personnel "are especially vulnerable to VBIs due to occupational contact with arthropod vectors, immunological naiveté to previously unencountered pathogens, and limited diagnostic and treatment options available in the austere and unstable environments sometimes associated with military operations."[20]

A recent case study - the Zika epidemic – helps illustrate this. Evidence suggests that climate change was a factor in the disease's proliferation – the unusually temperate 2015 El Niño likely amplified the spread of the disease,[21] while epidemiological modeling concludes that climate change had produced the most optimal conditions for mosquito-borne transmission of Zika since 1950, with higher simulated biting rates, lower mosquito mortality rates, and lower extrinsic incubation periods.[22]

The effects of this have been felt across civilian and military populations alike. As of December 2016, there were 4,809 Zika cases reported in the continental United States, and an additional 33,865 cases reported in U.S. territories like Puerto Rico.[23] Among active U.S. military personnel and their dependents, Pentagon officials have confirmed at least 41 reported cases contracted in the line of service,[24] prompting the Walter Reed Army Institute of Research (WRAIR) to describe a safe and effective Zika vaccine as an urgent global health priority.[25] Given the aforementioned connection between vector-borne illness and the climate, WRAIR and other DoD organizations that focus on infectious disease surveillance will become increasingly important in the years to come.

And it is not just mosquitoes that policymakers should be concerned with; aside from the traditional VBI transmitters, hundreds of species (eg. ubiquitous rodents, birds, and livestock) can serve as disease reservoirs, each with complex zoological interactions with the climate, and each with the possibility to cause full-scale pandemics if the mitigation and control efforts are mismanaged.

Moved into Harm's Way: Health Security in Extreme Weather Events, Natural Disasters, and International Conflict

The previous section described how climate change can increase the transmission of illnesses to military personnel, putting their health and safety at risk. But when considering the suite of military, development, and philanthropic responses typically employed by American coordinating agencies like the DoD or USAID to engage internationally, it becomes clear that climate change can intersect with health and security in additional, meaningful ways. This section will describe two major climate-connected categories of events that simultaneously (1) increase the presence of U.S. personnel in regions at high risk for disease transmission and (2) increase the likelihood of disease transmission and difficulty of treatment in these regions. They are extreme weather events/natural disasters and international conflicts/refugee crises.

Extreme weather events and natural disasters are defined by the National Centers for Environmental Information (NCEI) – formerly the National Climatic Data Center (NCDC) – as including heat waves, tornadoes, hurricanes, tropical cyclones, severe storms (tornadoes, hail, and straight-line winds), wildfires, crop freeze events, and winter storms[26] as well as what the DoD defines as "persistently recurring conditions" such as flooding and drought.[27]

Scientific evidence suggests that global warming can increase both the frequency and severity of these extreme events, with most of the evidence concentrating on heat waves,[28] precipitation and flood risks,[29] hurricane seasons,[30] and storms, tropical cyclones, and monsoons.[31] Insofar as climate change can expand and intensify the risks of these extreme events, more and more U.S. military and development personnel may be deployed in humanitarian assistance and disaster relief (HA/DR) abroad.

Climate-driven extreme events can themselves also exacerbate the underlying factors behind disease transmission, making HA/DR deployment locations more dangerous. For example, short- term increases in temperature and rainfall have been linked to accelerated parasite development that led to Plasmodium falciparum malaria epidemics and Rift Valley fever in Kenya.[33] Should the U.S. deploy humanitarian support to the region, they would have found themselves at heightened risk.

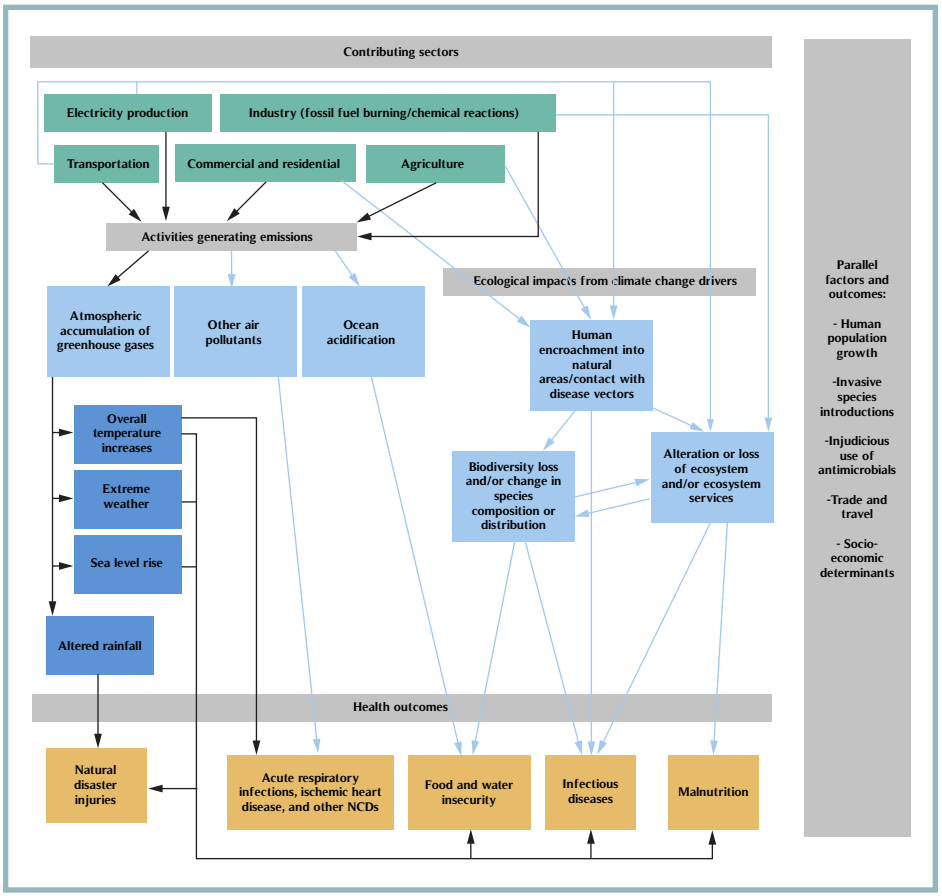

FIGURE 1: A map of how climate change can drive a variety of health risks such as infectious diseases and natural disasters through climate-driven extreme weather events, abetted by increased migration and deployment into areas with disease vectors.

SOURCE: *Climate Change and Health: Transcending Silos to Find Solutions.*[32]

These extreme events and natural disasters don't just have implications for individuals working overseas in military or aid capacities. A study in *PLoS Neglected Tropical Diseases* suggests that the Gulf Coast of the southern United States – home to a number of critical military bases and sites – is increasingly at risk of infectious diseases, in part because "periodic exposures to climate and environmental hazards, including hurricanes, floods, droughts, and oil spills" amplify risk factors such as poverty and poor sanitation.[34] Looking nationally, the NCEI estimates through its monitoring systems that the United States has experienced more than 200 such extreme events since 1980 in which overall damages were above USD $1 billion – at a total cost exceeding USD $1.1 trillion.[35] Globally, such estimates are more difficult to quantify, but are in fact both more frequent and more devastating in temperate climates with less developed infrastructure and response capacities – often the very places that most need American HA/DR responses.

Military missions have similarly been shaped by disease and climatic factors over the course of human history. Consider the spread of pandemic influenza in 1918 across U.S. military bases and army training camps in the First World War.[36] More recently, this has manifested itself in very real ways, such as the spread of Old World cutaneous leishmaniasis across areas of Syria and Iraq occupied by the Islamic State.[37]

The climate/health/security linkages are clear, and the security community has already taken notice. For instance, the U.S. *National Security Strategy* suggests that climate change has contributed to increased refugee flows and conflicts over basic resources such as food and water, thereby driving more substantial troop deployments into regions with high risk for disease transmission.[38] The World Bank reinforces this position, suggesting that climate change has significant implications for armed conflict and refugee movement given its intensification of natural disasters, deepening of resource scarcities, and effect on rising sea-levels.[39]

Moreover, these climate-assisted conflicts and migratory patterns can themselves drive outbreaks that endanger military and aid personnel. Research points to the spread of kala-azar across East Africa as a result of the conflict in South Sudan,[40] which itself has been intensified by climate change and drought according to the nation's environment minister, Deng Deng Hoc Yai.[41] It is clear, therefore, that military and aid deployments to these locations of heightened disease transmission risk present a health security challenge that policymakers will have to integrate into long-term policy and planning.

Conclusion: A Black Swan Song

There are many interconnected and overlapping chains of causality in this report. Climate change contributes to extreme weather events, natural disaster, conflict, and migration in a way that threatens the health of civilians as well as of military and HA/DR personnel. These events - as well as climate change in and of itself - also augment disease transmission in at-risk regions, particularly related to VBIs and other infectious diseases – which would be particularly worrying in an outbreak or pandemic scenario. Taken together, this is an important emerging risk trend for security and health policymakers across the world.

Though the mortality burden of such effects may be considered comparatively low (when judged against other security risks), this status quo is not assured. The *National Intelligence Council*'s Global Trends 2030 report identifies pandemic threats as the Black Swan externality with the greatest potential to disrupt the international system and cause widespread death and suffering.[42] This presents the threat posed by climate change in stark relief, given the potential for a climate-augmented pandemic as an existential international security event.

Therefore, what makes climate change and health security such an important intersection for policy analysis and investment is precisely this double potency as an amplifier: a warming climate can multiply the impact of existing threats and vulnerabilities in indigenous settings and also empower these local threats to potentially become global in nature.

Notes

1 Research Fellow, The Center for Climate and Security

2 National Intelligence Council, "The Global Infectious Disease Threat and Its Implications for the United States," January 2000, accessed at: http://www.dni.gov/nic/PDF_GIF_otherprod/infectiousdisease/infectiousdiseases.pdf

3 Kaiser Family Foundation, "The U.S. Department of Defense and Global Health," September 2012, available at https://kaiserfamilyfoundation.files.wordpress.com/2013/01/8358.pdf

4 Military Health System, "Assistant Secretary of Defense for Health Affairs," accessed at http://www.health.mil/About-MHS/ASDHA

5 Military Health System, "Deputy Assistant Secretary of Defense for Health Readiness Policy and Oversight," accessed at http://www.health.mil/About-MHS/Leadership-Biographies/David-J-Smith-MD

6 Jon Barnett, "Security and climate change," *Global Environmental Change* 13, 2003.

7 U.S. Department of Defense, "Hagel to Address 'Threat Multiplier' of Climate Change," October 13, 2014, accessed at https://www.defense.gov/News/Article/Article/603440

8 Oliver Milman, "Military experts say climate change poses 'significant risk' to security," *The Guardian*, September 14, 2016, accessed at https://www.theguardian.com/environment/2016/sep/14/military-experts-climate-change-significant-security-risk

9 U.S. Department of Defense, "DoD Directive 4715.21," January 14, 2016, accessed at http://www.dtic.mil/whs/directives/corres/pdf/471521p.pdf

10 U.S. Department of Defense, "2014 Climate Change Adaptation Roadmap," January 2014, accessed at http://www.acq.osd.mil/eie/Downloads/CCARprint_wForward_e.pdf

11 U.S. Congressional Report, "National Security Implications of Climate-Related Risks and a Changing Climate," May 2015, aaccessed at http://archive.defense.gov/pubs/150724-congressional-report-on-national-implications-of-climate-change.pdf?source=govdelivery

12 Peter Hotez, "2017 Global Infectious Diseases Threats to the United States," *PLoS Neglected Tropical Diseases,* December 22, 2016, accessed at http://blogs.plos.org/speakingofmedicine/2016/12/22/2017-global-infectious-diseases-threats-to-the-united-states/

13 Kaiser Family Foundation, "The U.S. Department of Defense and Global Health," September 2012, accessed at https://kaiserfamilyfoundation.files.wordpress.com/2013/01/8358.pdf

14 World Health Organization, "Vector-borne diseases," February 2016, accessed at http://www.who.int/mediacentre/factsheets/fs387/en/

15 Military Health System, "Global Emerging Infections Surveillance and Response System," accessed at http://www.health.mil/Military-Health-Topics/Health-Readiness/Armed-Forces-Health-Surveillance-Branch/Global-Emerging-Infections-Surveillance-and-Response

16 World Health Organization, "Climate change and human health: risks and responses," 2003, accessed at http://www.who.int/globalchange/publications/climchange.pdf

17 Leopoldo Rueda, *et al.*, "Temperature-dependent development and survival rates of Culex quinquefasciatus and Aedes aegypti," *Journal of Medical Entomology* 27, 1990.

18 Mick Gillies, "The duration of the gonotrophic cycle in Anopheles gambiae and An. funestus with a note on the efficiency of hand catching," *East African Medical Journal* 30, 1953.

19 Andrew Githeko *et al.*, "Climate change and vector-borne diseases: a regional analysis," *Bulletin of the World Health Organization* 78, 2000.

20 Mark Fukuda *et al.*, "Malaria and other vector-borne infection surveillance in the U.S. Department of Defense Armed Forces Health Surveillance Center-Global Emerging Infections Surveillance program: review of 2009 accomplishments," *BMC Public Health* 11, 2011.

21 Chelsea Harvey, "El Niño on a warming planet may have sparked the Zika epidemic, scientists report," *Washington Post*, December 19, 2016, accessed at https://www.washingtonpost.com/news/energy-environment/wp/2016/12/19/el-nino-on-a-warming-planet-may-have-sparked-the-zika-epidemic-scientists-report/?utm_term=.61788f7dbac9

22 Cyril Caminade *et al.*, "Global risk model for vector-borne transmission of Zika virus reveals the role of El Niño 2015," *Proceedings of the National Academy of Sciences* 114, 2016.

23 Centers for Disease Control and Prevention, "Zika Virus Case Counts in the US," January 4, 2017, accessed at https://www.cdc.gov/zika/geo/united-states.html

24 Barbara Starr, "41 US military members have now contracted Zika," *CNN*, August 3, 2016, accessed at http://www.cnn.com/2016/08/03/politics/zika-33-military-members-contract-disease/

25 Peter Abbink *et al.*, "Protective efficacy of multiple vaccine platforms against Zika virus challenge in rhesus monkeys," *Science* 353, 2016.

26 National Centers for Environmental Information, "Extreme Events," accessed at https://www.ncdc.noaa.gov/climate-information/extreme-events

27 U.S. Congressional Report, "National Security Implications of Climate-Related Risks and a Changing Climate," May 2015, accessed at http://archive.defense.gov/pubs/150724-congressional-report-on-national-implications-of-climate-change.pdf?source=govdelivery

28 United States Global Change Research Program, "Climate Change Impacts in the United States: The Third National Climate Assessment," 2014, accessed at http://s3.amazonaws.com/nca2014/low/NCA3_Full_Report_0a_Front_Matter_LowRes.pdf?download=1

29 Gregg Greenough *et al.*, "The potential impacts of climate variability and change on health impacts of extreme weather events in the United States." *Environmental Health Perspectives* 109, 2001.

30 Maarten Van Aalst, "The impacts of climate change on the risk of natural disasters," *Disasters* 30, 2006.

31 Earth Observatory, "The Impact of Climate Change on Natural Disasters," accessed at http://earthobservatory.nasa.gov/Features/RisingCost/rising_cost5.php

32 Catherine Machalaba *et al.*, "Climate change and health: transcending silos to find solutions," *Annals of Global Health* 81, 2015.

33 Andrew Githeko *et al.*, "Climate change and vector-borne diseases: a regional analysis," *Bulletin of the World Health Organization* 78, 2000.

34 Peter Hotez *et al.*, "The Gulf Coast: a new American underbelly of tropical diseases and poverty," *PLoS Neglected Tropical Disease* 8.5, 2014.

35 National Centers for Environmental Information, "Billion-Dollar Weather and Climate Disasters," 2016, accessed at https://www.ncdc.noaa.gov/billions/

36 Peter Wever, "Death from 1918 pandemic influenza during the First World War," *Influenza and Other Respiratory Viruses* 8.5, 2014.

37 Rebecca Du *et al.*, "Old World Cutaneous Leishmaniasis and Refugee Crises in the Middle East and North Africa," *PLoS Neglected Tropical Diseases* 10.5, 2016.

38 White House, "National Security Strategy," February 2015, accessed at https://www.whitehouse.gov/sites/default/files/docs/2015_national_security_strategy.pdf

39 World Bank Group, "Implications of Climate Change for Armed Conflict," February 25, 2008, accessed at http://siteresources.worldbank.org/INTRANETSOCIALDEVELOPMENT/Resources/SDCCWorkingPaper_Conflict.pdf

40 Waleed Al-Salem *et al.*, "A review of visceral leishmaniasis during the conflict in South Sudan and the consequences for East African countries," *Parasites & Vectors* 9.1, 2016.

41 Sophie Yeo, "Climate impacts fuelling South Sudan war says minister," *Climate Home*, May 30, 2014, accessed at http://www.climatechangenews.com/2014/05/30/climate-impacts-fuelling-south-sudan-war-says-minister/

42 National Intelligence Council, "Global Trends 2030: Alternative Worlds," 2012, accessed at https://www.dni.gov/files/documents/GlobalTrends_2030.pdf