MCCS
EXPERT GROUP

THE WORLD CLIMATE AND SECURITY REPORT 2020

A Product of the Expert Group of the

INTERNATIONAL MILITARY COUNCIL ON CLIMATE AND SECURITY

FEBRUARY 2020

THE CENTER FOR CLIMATE AND SECURITY

COUNCIL ON STRATEGIC RISKS

Clingendael
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The Hague Centre for Strategic Studies

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Cover Photo:
U.S. Army Service Members return to the U.S. Virgin Islands to assist with disaster relief operations in response to Hurricanes Irma and Maria, Sept. 23, 2017. U.S
U.S. Army / Pvt. Alleea Oliver/Released

The International Military Councilon Climate and Security (IMCCS) is a group of senior military leaders, security experts, and security institutions across the globe dedicated to anticipating, analyzing, and addressing the security risks of a changing climate. The IMCCS is co-led by:

IMCCS Secretary General
The Honorable Sherri Goodman
Former Deputy Undersecretary of Defense (Environmental Security)
US Department of Defense
Senior Strategist, The Center for Climate and Security

IMCCS Chair
General Tom Middendorp (Ret)
Former Chief of Defence of the Netherlands
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The IMCCS Expert Group consists of IMCCS leaders committed to driving analysis, policy and communications on climate and security, including through the development, publication and endorsement of the World Climate and Security Report, as well as other timely analysis driven by demand signals from the IMCCS. The IMCCS Expert Group currently consists of representatives from four institutions:

- The Center for Climate and Security (CCS), an institute of the Council on Strategic Risks (CSR)
- The Planetary Security Initiative at the Netherlands Institute of International Relations (Clingendael)
- *The Hague* Centre for Strategic Studies (HCSS)
- The French Institute for International and Strategic Affairs (IRIS)

This report should be cited as: "The World Climate and Security Report 2020." Product of the *Expert Group of the International Military Council on Climate and Security*. Authors: Steve Brock (CCS), Bastien Alex (IRIS), Oliver-Leighton Barrett (CCS), Francesco Femia (CCS), Shiloh Fetzek (CCS), Sherri Goodman (CCS), Deborah Loomis (CCS), Tom Middendorp (Clingendael), Michel Rademaker (HCSS), Louise van Schaik (Clingendael), Julia Tasse (IRIS), Caitlin Werrell (CCS). Edited by Francesco Femia & Caitlin Werrell. Published by the Center for Climate and Security, an institute of the Council on Strategic Risks. Feb 2020.

FOREWORD

The inaugural *World Climate and Security Report 2020* from the Expert Group of the International Military Council on Climate and Security (IMCCS) provides global and regional assessments of the security risks of a changing climate, as well as opportunities for addressing them. It is the first report of its kind, and is intended to inform future climate and security policy and analysis. This report addresses a broad spectrum of the security risks of climate change, including:

- Where human security risks spill over into higher-order security risks, such as political instability, conflict, major natural disasters involving significant military and humanitarian responses, mass displacements of peoples, and threats to critical resources and infrastructure
- Geopolitical impacts of climate change including regional and inter-state tensions and conflicts
- Impacts of climate change on military and defense, including military infrastructure, force readiness, military operations and military strategy

The report is anchored by a contemporary, global survey of the climate security landscape from the vantage point of international military and security expert contributors.

On the risks side, the report includes a Global and Regional Risk Overview - a description of the most current knowledge on the intersection of climate change and security at the regional and international level. This section also includes a Climate Security Risk Perception Survey, which is the first survey to assess perceptions of risk among military and security professionals who are concerned about climate change.

Regarding opportunities for addressing those risks, the report includes initial results from a Climate Security Strategic Capability Game - a unique gaming approach that aims to increase awareness about relevant capabilities and capacities that are needed for conflict prevention and response in the context of climate change. Further, the report highlights some best climate security practices among national militaries and national security establishments, as well as intergovernmental security and military institutions, and explores how climate change is being incorporated into defense strategy and policy, and national and international military operations. The report concludes with recommendations for the way forward.

The report clearly shows that climate change is a matter of national and global security. Consequently, the international security community has a responsibility to prepare for and to prevent the security risks of climate change, as well as a responsibility to cooperate to meet this unprecedented threat.

Signed,

The Honorable Sherri Goodman
Secretary General
The International Military Council on Climate and Security

General Tom Middendorp (Ret)
Chair
The International Military Council on Climate and Security

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KEY RISKS AND OPPORTUNITIES

Key Risks: Significant or higher risks to global security under current circumstances

1. Climate change-exacerbated water insecurity is already a significant driver of instability, and according to 93% of climate security and military experts surveyed for this report, will pose a significant or higher risk to global security by 2030.

2. Though fragile regions of the world are facing the most severe and catastrophic security consequences of climate change, all regions are facing significant or higher security risks due to the global nature of the risks. For example, 86% of climate security and military experts surveyed for this report perceive climate change effects on conflict within nations to present a significant or higher risk to global security in the next two decades.

3. As reinforced by the 31 nations represented in the International Military Council on Climate and Security (IMCCS), an increasing number of national, regional and international security and military institutions are concerned about, and planning for, climate change risks to military infrastructure, force readiness, military operations, and the broader security environment.

4. Climate mitigation, adaptation and resilience efforts are increasingly urgent to avert the significant security consequences of climate change, yet some proposed solutions such as geoengineering could present negative second-order effects to global security, if not implemented carefully.

5. Rising authoritarianism, sharpened global competition and national agendas are hampering the needed cooperation among nations to address the security risks of climate change.

Key Opportunities: A path forward for global security cooperation on climate change

1. National, regional, and international security institutions and militaries around the world should advance robust climate resilience strategies, plans and investments, especially regarding climate implications for water and food security and their associated effects on stability, conflict and displacement, in their primary mission sets or lines of effort.

2. Security and military institutions should demonstrate leadership on climate security risks and resilience and encourage governments to advance comprehensive emissions reductions and adaptation investments to avoid those security disruptions. Military organizations can also lead by example through taking advantage of the significant opportunities to adopt lower carbon energy sources, and make progress on other greenhouse gases beyond carbon dioxide.

3. Climate-proofing development assistance for vulnerable nations which are likely hotspots of instability and conflict, as well as climate-proofing other policies affecting those regions, should be a priority for conflict prevention. Assistance should be aimed at climate resilience challenges such as water security, food security, and disaster preparedness.

4. The international community should embrace a Responsibility to Prepare and Prevent framework, given unprecedented foresight capabilities regarding the unprecedented risks of climate change.[1] This includes ensuring all levels of government and civil society, including all national, regional and international security institutions, are prepared for the security implications of climate change.

5. Security institutions around the globe should integrate climate knowledge and training into institutional frameworks to ensure that knowledge and understanding of climate change threats permeates the organizational culture. For example, climate security curricula should be added to national and regional training and defense colleges, professional military education, and climate security should receive significant treatment in international security and military fora.

1 Caitlin Werrell and Francesco Femia. "The Responsibility to Prepare and Prevent: A Climate Security Governance Framework for the 21st Century." *The Council on Strategic Risks/ The Center for Climate and Security*. October 2019. https://climateandsecurity.org/the-responsibility-to-prepare-and-prevent-a-climate-security-governance-framework-for-the-21st-century/

EXECUTIVE SUMMARY

The World Climate and Security Report 2020 (WCSR 2020) is a global assessment of the security risks of a changing climate and opportunities for addressing them, conducted by a unique high-level Expert Group of the International Military Council on Climate and Security (IMCCS). In addition to the Key Risks and Opportunities above, and this Executive Summary, the WCSR 2020 includes five distinct and interrelated chapters. These chapters are broken up into two themes: "Risks" and "Opportunities."

RISKS

I. Global and Regional Risk Overview: The IMCCS Expert Group conducted an overview of global climate change and security risks based on a review and aggregation of existing literature and information, and a summary of critical risks across regions. Each nation and region faces its own variation of climate change-related threats, and societal dynamics that influence how gravely those threats are already being felt, and how fraught mitigation and adaptation decisions will be. Around the world nations are wrestling with challenges of too much or too little water, and associated strains on food and water systems. Increased political instability and conflict, as well as mass displacements of people, have been identified as significant future risks as global warming effects such as extreme heat, drought, sea level rise, and saltwater intrusion in aquifers, render these critical systems increasingly strained. This chapter presents an overview of specific climate security threats in the Indo-Asia Pacific, South and Central America, the Caribbean, Europe, Africa, the Middle East, Arctic and North America.

II. Climate Security Risk Perception Survey Results: The IMCCS Expert Group administered a survey in December 2019 to assess the perceptions of climate security risks among a select group of 56 security and military experts and practitioners from across the globe, most of whom are familiar with climate security dynamics as either practitioners or analysts, and many of whom are IMCCS Participants, Observers or members of its Leadership. Specifically, this survey assessed perceptions on how these changes will affect global security over three time periods: 1 year from 2020, 10 years from 2020 and 20 years from 2020. The top three findings from this survey are:

> ***2020-2040: Rapidly increasing risks to global security.*** 100% of the climate security risks assessed will increase in the next twenty years (2020-2040) - most to significant or higher levels for global security – according to the respondents.
>
> ***2030: Significant or higher risks to global security from water stress.*** 93% of the security and military respondents perceived that climate change effects on water security will present significant or higher risks to global security in ten years (2030), and 91% perceived those risks as severe or catastrophic in twenty years (2040).
>
> ***2040: A confluence of significant risks to global security.*** Most of the security and military respondents perceive that climate change effects on the following phenomena will present a significant or higher risk to global security in twenty years (2040): Water security (98% of respondents); Forced displacement and scale and tempo of natural disasters (96%); Food security (94%); Conflict within nations (86%); Conflict between nations (79%).

OPPORTUNITIES

III. Climate Security Game Results: The Climate Security Strategic Capability Game is a tool designed with the aim of increasing awareness about relevant capabilities and capacities that are needed for conflict prevention in the context of climate change; to address what climate change will mean for the planning of policies, activities and operations of different ministries; and to discuss the role of militaries in climate change prevention, response and reconstruction. Over a one-year period, several rounds were played with participants from around the globe. During the game, players became aware of the broad spectrum of capabilities that are required to create more resilience and mitigate climate-induced insecurity and realized that a multidisciplinary approach is required. Most participants concluded that they did not oversee all required and/or possible capabilities upfront and concluded that it enriched their insight and understanding. Participants considered the game useful in helping structure their thoughts, and decide which capability developments to prioritize. The game is a useful tool to enable decision makers to make choices on how to deploy these climate security capabilities in ways that will be increasingly important in the foreseeable future.

IV. Highlights – Best Practices on Climate and Security: This chapter highlights best practices among select nation's militaries and national security establishments, as well as intergovernmental security and military institutions, on addressing climate and security risks. IMCCS Expert Group authors reviewed the efforts of 12 national militaries chosen based on indications that they have begun considering the implications of climate change for their armed forces. For each of the countries, the authors interviewed national experts and conducted a review of literature and policy documents, looking at how and to what extent climate change considerations had been integrated into areas such as risk assessment, operations, and equipment. The review makes clear that often times climate change not only acts as a threat multiplier in theaters of operations, but it can also have direct implications for military capabilities, since it can lead to additional domestic calls for assistance to civil actors. In some cases, climate change can even directly affect military capabilities and strength, since extreme weather and floods place a substantial additional burden on the overall capacity to act.

V. Conclusions and Recommendations - Global Security Cooperation: This section summarizes and analyzes the broad sweep of the report, and offers a more comprehensive set of conclusions and recommendations for *a path forward towards global security cooperation on climate change*. This includes the overarching recommendation that national, regional, and international security institutions and militaries around the world acknowledge climate security risks and advance climate resilience, especially water and food security and their associated effects on stability, conflict and displacement, in their primary mission sets or lines of effort.

RISKS

I. GLOBAL AND REGIONAL RISK OVERVIEW

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KEY DEFINITIONS

The term "climate security risks" in this chapter does not include *all* climate change impacts - as that would lead us to an exhaustive and often redundant analysis - though the spectrum is still very broad. Rather, it refers to impacts that meet any one of the following criteria:

- Where human security risks spill over into higher-order security risks, such as political instability, intra-state conflict, major natural disasters involving significant military responses, mass displacements of peoples, threats to critical resources and infrastructure
- Inter-state tensions and conflicts related to climate change
- Impacts of climate change on military and defense, including military infrastructure, force readiness, military operations and military strategy

INTRODUCTION

This is a contemporary overview of global and regional climate and security risks based on a review and aggregation of existing literature and information, and a summary of critical risks across regions. It is written from the vantage point of international security expert contributors. The key learnings we derive and the recommendations we make are based on our interpretation of the literature deriving from collective decades as researchers in the field, and military and security leaders.

For organizational purposes, we have divided the world into seven regions: Africa; the Arctic; Europe; the Indo-Asia Pacific; the Middle East; North America; and South and Central America and the Caribbean. Within those regional chapters, we have also highlighted a select number of sub-regional distinctions, including individual national and transboundary case studies. Of course, the climate knows no geopolitical boundaries and many of its impacts cross borders between nations and these artificially delineated regions. Before delving into the particulars of how climate change is affecting security in specific regions and countries, we provide the following overarching observations that we have seen across almost every region and that reflect a commonality of experience and challenges.

First, climate change often poses a double burden in already fragile states or societies. Specifically, climate change stressors can make it difficult for fragile states, or brittle states[1] that seem stable but contain serious vulnerabilities, to handle increasingly intense or frequent phenomena such as persistent droughts, flooding, or natural disasters. Then, when these states fail to meet critical public needs such as reliable supplies of food and water, the public perceives the state as illegitimate, ineffective, or both, further undermining its legitimacy.[2] This reality, in turn, can cause people to turn to other organizations (such as extremist groups) to provide basic needs, or to migrate. A recent World Bank report focusing on Sub-Saharan Africa, South Asia and Latin America predicts that climate change will push tens of millions of people to migrate within their countries by 2050. It also projects that, "without concrete climate and development action, just over 143 million people...could be forced to move within their own countries to escape the slow-onset impacts of climate change. They will migrate from less viable areas with lower water availability and crop productivity and from areas affected by rising sea level and storm surges."[3]

Second, a growing body of research links climate change to an increased likelihood of conflict, especially in places with existing tensions. A recent study published in the *Proceedings of the U.S. National Academy of Sciences* found evidence in global datasets that risk of armed-conflict outbreak is enhanced by climate-related disaster occurrence in ethnically fractionalized countries. Based on data on armed conflict outbreaks and climate-related natural disasters between 1980-2010, their analysis concluded that about 23% of conflict outbreaks in ethnically highly fractionalized countries robustly coincide with climatic calamities such as heat waves or droughts.[4] An earlier study analyzed 60 quantitative studies of conflict data sets and similarly found "strong causal evidence linking climatic events to human conflict across a range of spatial and temporal scales and across all major regions of the world." Specifically, for each one standard deviation change in climate toward warmer temperatures or more extreme rainfall, the frequency of interpersonal violence rises 4% and the frequency of intergroup conflict rises 14%. The paper noted that this is significant because many areas throughout the inhabited world are expected to warm between two and four standard deviations by 2050.[5]

Thirdly, however, the threat is not just limited to unstable societies. This overview finds that climate change-exacerbated natural disasters may act as threat multipliers in both the world's most fragile regions, and in more stable regions with underlying and underreported climate vulnerabilities.

Lastly, the upside of this confluence of factors is that addressing the underlying problems such as water and food insecurity could enhance resilience while also reducing fragility. As set forth in a recent report from the US Agency for International Development (USAID):

> *"Poor state legitimacy—that is, public perceptions that the state is unwilling or unable to meet public needs—contributes more to the fragility of states, on average, than poor state effectiveness does. State actions that respond to the public's need for reduced climate vulnerability could thus simultaneously reduce both climate risks and the legitimacy deficits that often contribute most heavily to fragility in these states."*[6]

For example, proactively building capacity to address climate change risks from floods or droughts can make these events less deadly and costly, while simultaneously enhancing public perceptions of government legitimacy. The level of security risk that societies confront in the future may depend heavily on whether or not governments are able (and/or willing) to continue fulfilling the social contract with their citizenry in the face of a rapidly-changing climate.

NOTES

1 Caitlin Werrell and Francesco Femia. "Climate Change, the Erosion of State Sovereignty, and World Order." *The Brown Journal of World Affairs.* Volume XII, Issue 2, Spring-Summer 2016, pp. 221-235

2 U.S. Agency for International Development. *The Nexus of Fragility and Climate Risks*, by Ashley Moran, Joshua W. Busby, Clionadh Raleigh, Todd G. Smith, Roudabeh Kishi, Nisha Krishnan, Charles Wight, and Management Systems International.Washington, DC, March 2019. https://pdf.usaid.gov/pdf_docs/PA00TBFH.pdf?mc_cid=9a663aa12f&mc_eid=d2eb3bc86b.

3 International Bank for Reconstruction and Development, The World Bank Group. *Groundswell: Preparing for Internal Climate Migration.* By Kanta Kumari Rigaud, Alex de Sherbinin, Bryan Jones, Jonas Bergmann, Viviane Clement, Kayly Ober, Jacob Schewe, Susana Adamo, Brent McCusker, Silke Heuser, and Amelia Midgley. Washington, DC, 2018. https://www.worldbank.org/en/news/infographic/2018/03/19/groundswell---preparing-for-internal-climate-migration

4 Carl-Friedrich Schleussnera, Jonathan F. Dongesa, Reik V. Donnera, and Hans Joachim Schellnhubera. "Armed-Conflict Risks Enhanced by Climate-Related Disasters in Ethnically Fractionalized Countries." *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 113, No. 33: 1 (August 16, 2016), https://www.pnas.org/content/pnas/113/33/9216.full.pdf.

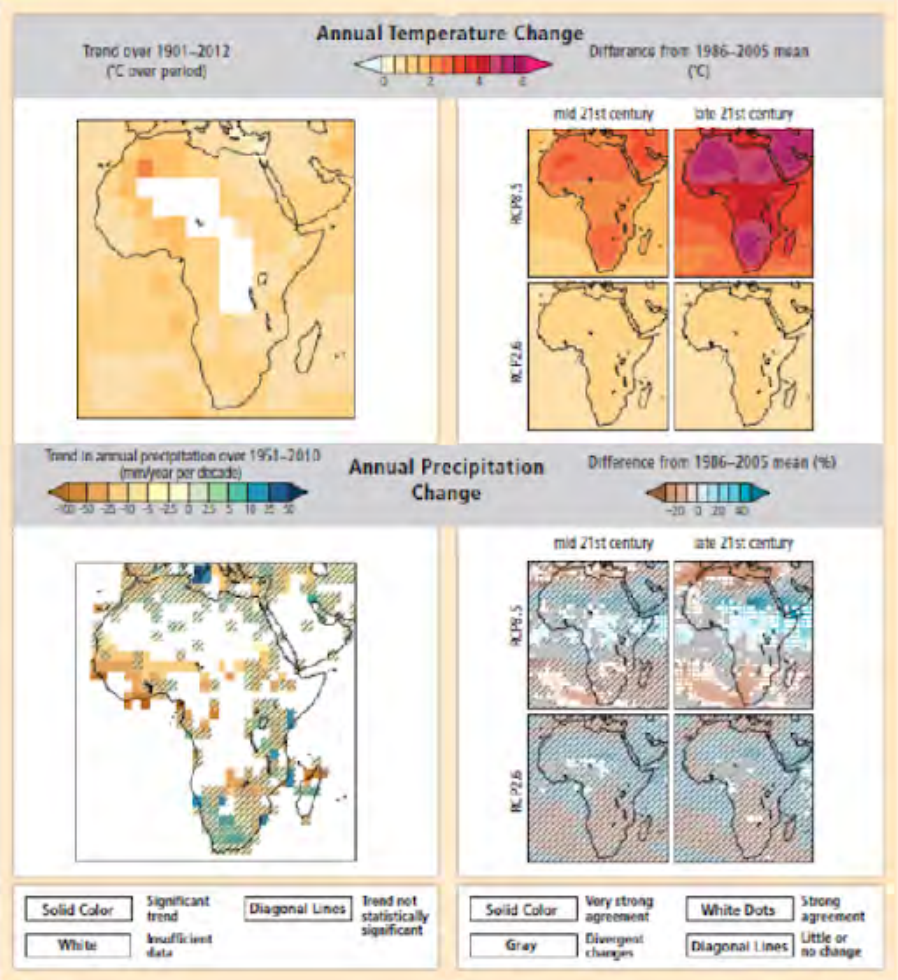
5 Solomon M. Hsiang, Marshall Burke, and Edward Miguel. "Quantifying the Influence of Climate on Human Conflict." *Science.* Vol. 341, Issue 6151, (Septemer 13, 2013). https://science.sciencemag.org/content/341/6151/1235367.

6 U.S. Agency for International Development. *The Nexus of Fragility and Climate Risks,* by Ashley Moran, Joshua W. Busby, Clionadh Raleigh, Todd G. Smith, Roudabeh Kishi, Nisha Krishnan, Charles Wight, and Management Systems International.Washington, DC, March 2019. https://pdf.usaid.gov/pdf_docs/PA00TBFH.pdf?mc_cid=9a663aa12f&mc_eid=d2eb3bc86b.

AFRICA

THE BROAD REGIONAL PICTURE OF CLIMATE SECURITY RISKS

Many experts believe that the African Continent will be the region hardest hit by climate change. Both geographic vulnerability to extreme climate outcomes and lower economic development and institutional strength will severely challenge the region's capacity to cope with climate change and its attendant consequences for instability and conflict. Advances in climate science and technology are now making it possible to more accurately map Africa's long-term climate projections. Although the image is still blurry, the contours are quite distinct and, for the most part, reflect rising temperature above the global average (+3 to 6°C); decreased average rainfall in the North, South and West, with increased rainfall in the East; interannual and inter-decadal variability will also increase significantly, making long-term forecasts more difficult; sea levels will rise, particularly from Mauritania to the Gulf of Guinea; extreme weather events such as heavy rainfall events are expected to increase in the Sahel region. These developments raise the specter of tension or even conflict over the scarcity of and competition for resources across Africa.



Observed and projected temperatures and precipitation changes.
IPCC, AR5WGII CHAPTER 22., P. 1207

Although climate impacts alone do not create instability, expected changes will exacerbate several known but not controlled risks, such as food security. African populations currently depend mainly on agriculture, fisheries and livestock despite a boom in the service sector in recent decades. These sectors are very much dependent on climate change. Increased water scarcity linked to variations in rainfall patterns will have (unless significant adaptation measures are implemented) a negative impact

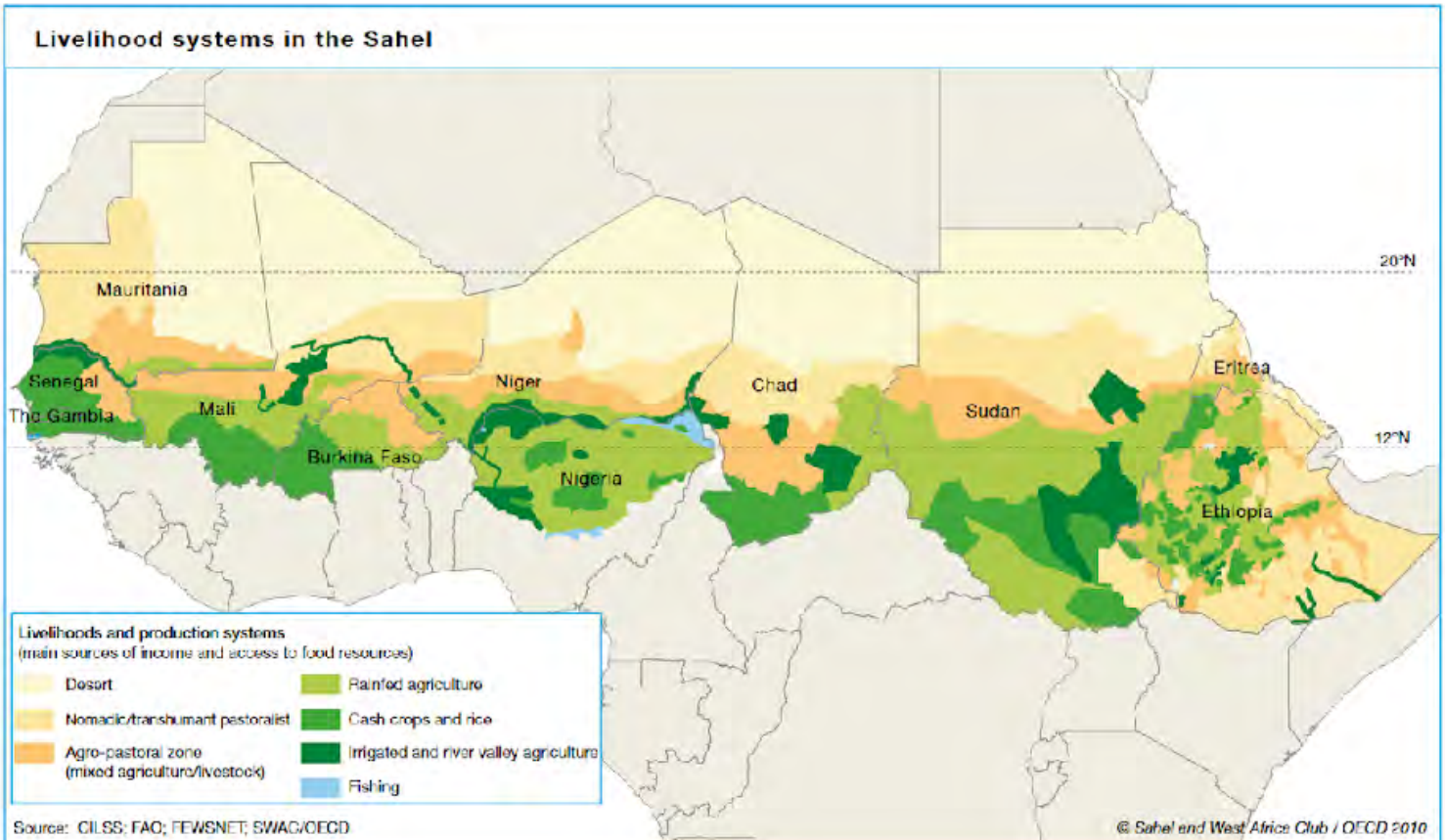
on agricultural yields of crops that are quite dependent on rainfall – including millet, corn, wheat and sorghum. Combined with demographic data, which predict a substantial increase in population, these developments could fuel massive rural exodus scenarios into already saturated cities and megacities. In addition, simultaneous crop failures in the world's major production basins could lead to excessive speculation or policies of import restrictions on international markets and new hunger riots, as in 2008.[1] Nevertheless, all these developments are heavily related to human capabilities to tackle the climate challenge, especially when it comes to resource management.

RESOURCE AVAILABILITY AND MIGRATION

Clashes between herders and farmers have been common in the Sahel for centuries. But in recent decades, they have often been presented as the first climate conflicts.[2] This is due to the fact that most nomadic herders are now depending on climatic variations (rainfalls which are insufficient or ill-distributed in time) and forced to go further south to graze and water their flocks.

Possibly no economic activities are as dependent on nature as farming, herding, and fishing. Tensions most often occur between herders and farmers due to land and crop degradation which can be caused by the passage of animals, the construction of fences or the lack of updated "transhumance corridors" – reliable paths for moving livestock from one rangeland to another in a seasonal cycle. However, responsibility for tensions is not purely one-sided as conflicts also arise from farmers moving north and expanding land cultivation with the support of public authorities or even international

Figure 2: Security Implications of Climate Change in the Sahel Region: Policy considerations, Philipp Heinrigs, OECD, 2012, Sahel and West Africa Club, p. 20.



donors. Tensions resulting from these land use conflicts, although foreseeable, are rarely proactively addressed or managed by public authorities. Local authorities are often insufficiently resourced to carry out complex arbitration of disputes and/or technical monitoring of projects, due to the lack of quality data and impact studies.[3] Livestock farmers may also be victims of a national strategy favoring agrarian "modernization" and the conversion of nomadic populations to sedentary production models.[4]The political dimension is also very significant, and the situation varies from country to country: depending on clan affiliation and ethnic background, some governments can be more inclined to support agriculture, domesticated livestock (ranches) or nomadic livestock herding, which remains dominant in the Sahel, for instance. Finally, the lethality of clashes may increase due to the growing presence of weapons in the region following the collapse of Libya in 2011.

As discussed above, climate change often plays a significant if secondary role in land conflicts, in combination with local political and economic factors. However, without solutions and policies adapted to local contexts, impacts of climate change will have a negative influence on conflicts over land and resources and could lead them to increase.

WATER MANAGEMENT

Contrary to narratives about "water wars," research on transboundary water resource management shows that states have historically tended to collaborate rather than engage in violent conflicts over water, though climate change may strain that cooperation in the future.[5] Studies also show that even where water-sharing leads to increased community tension and violence at the local level, these tensions do not necessarily lead to war.[6] Although the possibility of a conventional conflict emerging remains

People queue to buy water at a grocery store in Milnerton, a suburb of Cape Town, on Feb. 3, 2019.
Mikhael Subotzky/Magnum Photos for TIME

low, it could materialize through an over-interpretation of the signals of scarcity. The challenge is to prevent this type of scenario from occurring in river basins, as studies carried out do not allow us to conclude on the potential, in terms of conflict, of water issues that will arise in the future in emblematic cases like Lake Chad, the Nile, or the Niger Delta. Of course, the question is also applicable for vast transboundary aquifer systems like the one combining Iullemeden, Taoudeni and Tanezrouft (shared by Algeria, Benin, Burkina Faso, Mali, Mauritania, Niger and Nigeria, over 2.5 million km²).

Water scarcity and water insecurity have also been a problem in more developed nations like South Africa. As we have seen throughout this report, climate change impacts there combined with other issues to deepen the water crisis in the country. Specifically, more and more people have migrated to cities in South Africa, which has strained infrastructure, and climate change has made normally regular rains more infrequent, driving increased water insecurity.[7] Another problem is stolen water: in the city of Durban, an estimated 35% of the city's water is stolen or given out illegally.[8] Even the prosperous Cape Town felt the sting of a severe water shortage when in 2018, after three years of drought, the city came within 90 days of the taps being shut off before the government imposed drastic consumption restrictions and rains finally came. The government's announcement of the gravity of the situation prompted water stockpiling, a drop in tourism bookings, and raised the prospect of civil unrest.[9]

HIGHLIGHT: CLIMATE CHANGE AND TERRORISM

More and more research is being conducted to better understand and assess the relationship between climate change and terrorism. A report published by the German think tank *adelphi* states that in some of the cases studied, environmental degradation - partly linked to climate change - combined with other factors (e.g. a weak state, lack of economic opportunities, low education levels, etc.) leads to the expansion of the influence of terrorist groups.[10]

In fact, the relationship between the vulnerability of populations (e.g. poverty, lack of education, sense of exclusion) and their permeability to arguments, or receptivity to the modes of action of terrorist groups, has been demonstrated many times.[11] However, the fact that it exists does not mean that it is automatic. Therefore, care and local contexts must be taken into consideration when assessing the likelihood of societal vulnerabilities contributing to an increase in terrorist recruitment and activity.

EXTREME WEATHER EVENTS

Droughts and floods are expected to become more intense and frequent. The eastern, southwest, and southern parts of the continent are expected to have increased drought risk due to climate change. Beyond progressive decreases in rainfall, the most problematic impact is expected to be the rising interannual variability that renders crop yield predictions far more complicated, with significant impacts on food security.[12]

Exposure to tropical cyclone risks is also increasing most in Africa compared to other continents, (particularly in Madagascar and Mozambique). In the Indian Ocean, climate change could also spread the impact zone of cyclones to the north,[13] and to the south as well. [14]

Although not caused by cyclones, floods are frequent in North, East and West Africa, as evidenced by recent episodes (2009, 2012, 2016, 2017). Deficient urban planning in large cities regularly leads to large scale disasters in many parts of the continent. For example, a 2013 study noted:

> *"From late July to late August 2012, rainfall in excess of 150% of normal totals was recorded in southeast Mauritania and adjacent areas in Mali, through the middle and lower Niger river basin in Mali, Niger, Nigeria and Cameroon, and the Lake Chad basin in Niger, Chad, Nigeria and Cameroon."*[15]

During this episode, Senegal recorded more than a meter and a half of water in Dakar, damaging 11,400 homes and displacing nearly 290,000 residents.[16] These heavy rainfall events raise a lot of challenges when it comes to both readiness and response.

In Africa, climatic trends must be considered alongside demographic growth and evolution of consumption habits, that will keep resources under pressure. According to some recent surveys, dependence on agricultural imports will continue to rise until 2050, projected to reach a high of 68% for Maghreb countries for instance.[17] Again, well-designed resource management policies could cope with such issues. Otherwise, impacts on crop yields, water availability and population displacement, particularly when it comes to transhumance migrations, could affect security and stability

SUB-REGIONAL DISTINCTIONS

CONFLICT: HERDERS AND FARMERS IN MALI, NIGERIA AND THE DEMOCRATIC REPUBLIC OF THE CONGO (DRC)

Conflicts between herders and farmers are frequently observed in this part of the world. Changes in precipitation patterns and an increase in interannual variations and droughts could exacerbate existing tensions, which are rooted in local politics as well as historical community-based rivalries.

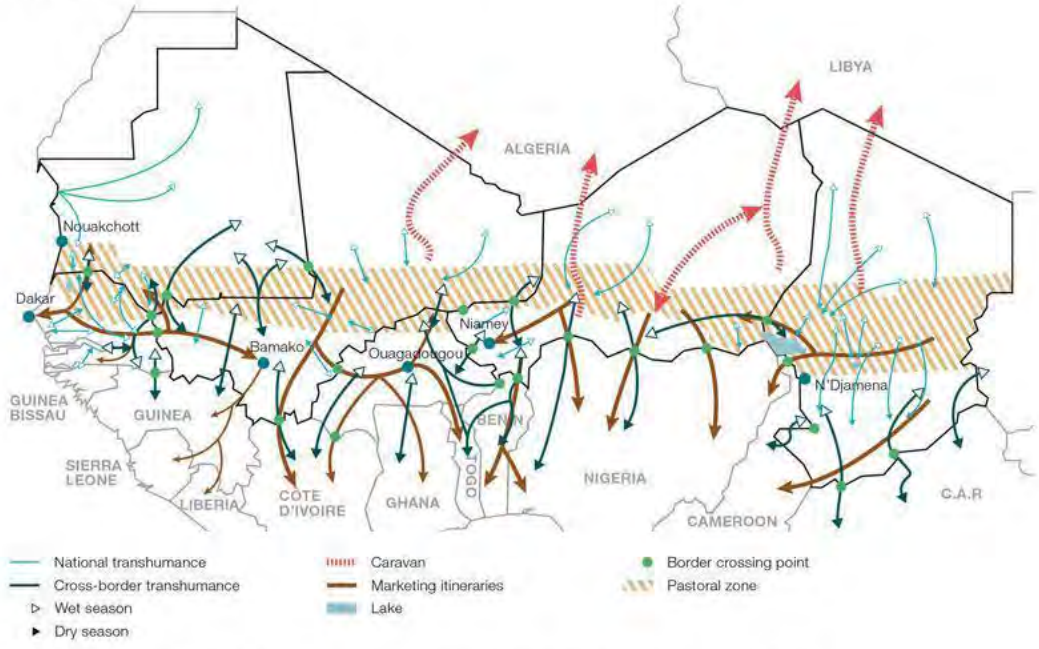
In a recent report, the UN Office for West Africa and the Sahel (UNOWAS) argued that there has been a non-uniform increase in the number of conflicts between herding and farming communities, attributing the increase to three main causes: demographic growth; climatic trends (less rain or too concentrated rainfall, creating floods on dry soils); use of small arms and light weapons (SALW); violent extremism from small terrorist and armed groups; public policies which arguably favor one ethnic or tribal group over others; and the lack of dispute settlement mechanisms.[18]

Three current herder-farmer conflict hotspots are: Mali, Nigeria and the DRC. In Mali, the jihadist leader Amadou Koufa, a former radicalized shepherd, is now head of the Group to Support Islam and Muslims (GSIM), linked to Al-Qaida, a movement whose number of fighters is difficult to estimate.

Its actions are now located in the center of the country and the Mopti region. There, the descent of the rainwater isohyets[19] by about 100km to the south has contributed to the difficulties of Fulani nomadic pastoralists, in competition with sedentary Dogon and Bambara farmers, for access to land and to bourgou, a plant prized for its nutritional qualities.[20] Nevertheless, the adherence of some Fulani to Koufa's radicalism is largely the result of groups like the GSIM instrumentalizing the government's policy of ostracism to rally supporters to their cause. Overall, the state has been absent from this region since 2013. Authorities in Bamako are unable to regain a foothold in the country or to respond to the concerns of pastoralists who are turning to opportunities offered by jihadist movements, which pay their followers' wages.[21] A cycle of violent inter-community reprisals has now begun. The Fulani, Dogon or Bambara villages are the target of abuses in which the army participates against the Fulani, assimilated by the Malian population to potential jihadists.[22] On March 23, 2019, 160 people - mainly Fulani - were massacred in Ogossagou by Dogon and Bambara self-defense groups, created in response to abuses by the Movement for Unity and Jihad in West Africa (MUJWA) and Group to Support Islam and Muslims (GSIM). [23]Climate change and ethnic rivalries are not proximate causes, but background factors in this exacerbated and instrumentalized political violence linked to the chaos in the country.

HTTP://WWW.WEST-AFRICA-BRIEF.ORG/CONTENT/EN/TRANSHUMANCE-AND-NOMADISM

TRANSHUMANCE AND NOMADISM IN SAHELIAN COUNTRIES



Sources: FAO-CIRAD, Atlas of trends in pastoral systems in the Sahel 2012; OECD/SWAC 2009
Extract: OECD (2014), An Atlas of the Sahara-Sahel: Geography, Economics and Security, OECD Publishing, Paris

In Nigeria, there is a similar dynamic except that the Fulani are generally perceived as members of Boko Haram. In this country of 190 million inhabitants, President Muhammadu Buhari's proposal to set aside areas for the settlement of Fulani populations (Ruga settlements) provoked an outcry from opposition leaders accusing him of supporting the Fulani community from which he came. Clashes mainly take place in the center of the country, in the states of Benue, Plateau, Adamawa, Nasarawa and Taraba. It can be difficult to distinguish between conflict triggered by climate-induced degradation of pasture[24] and the ongoing, persistent cycle of violence in the country. Nonetheless, according to some estimates, the conflict over pastoralism has resulted in more victims than the conflict with the terrorist organization in 2016, six times more in 2018 and more than 4000 victims since then.[25] This phenomenon shows again how climate-exacerbated natural resource stress and population displacements, coupled with fragile conditions on the ground, can cause already sensitive situations to flare into violence.

In the DRC, such conflicts occur between the Hema, nomadic pastoralists and Lendu farmers in Ituri State in the north-east of the country, on the border with southern Sudan and Uganda. Operating on a similar basis as described above, cycles of violence continue, with one of the latest attacks causing the death of 161 people in the Hema community on June 17, 2019.[26] Even if climate change is not considered as the proximate factor, its future impacts on the environment and agricultural yields could, if governance and the political situation does not improve, aggravate existing conflict dynamics.[27]

GREAT ETHIOPIAN RENAISSANCE DAM

On this subject, the most emblematic case study remains the sharing of the Nile waters between upstream and downstream countries. Dependent on 95% of the river's waters, Egypt is concerned about the progress of the Grand Ethiopian Renaissance Dam (GERD) project on the Blue Nile, which has been under construction since 2011. After some significant episodes of tension, Egypt and Ethiopia signaled their goodwill by signing an agreement in March 2015 recognizing Ethiopia's right to build the structure in exchange for the assurance that it would not harm Egypt's water supply.[28] However, no one can be sure that these two objectives are compatible.

The environmental impact study for the dam is still being carried out while construction of the project is more than 60% complete. The final study may never be published due to the difficult working context for its authors, revealed by Deltares' resignation.[29] Many meetings have been held between the two countries, as well as Sudan (which is now a close Ethiopian ally) without any significant progress on the schedule of the reservoir filling phase. Ethiopia wants this completed very quickly (to be finished in roughly two years) to begin generating electricity. Egypt wants this to occur as far in the future as possible to delay the impact on the Nile flow, which is already expected to suffer a more volatile flow rate due to climate change. In April 2017, an article in *Nature Climate Change* reported that "the standard deviation describing interannual variability of total Nile flow could increase by 50% (±35%)", attributed to projected increases in future occurrences of El Niño and La Niña events. [30]The authors concluded that, "adequacy of current water storage capacity and plans for additional storage capacity in the basin will need to be re-evaluated," lobbying for more "knowledge about the future flow of the Nile river […] to guide water resources planning, including proposals for dams and hydropower projects like the Grand Ethiopian Renaissance Dam (GERD)," acknowledging that at the moment, "the lack of consensus [on] the impacts of climate change on the Nile river flow hinders the

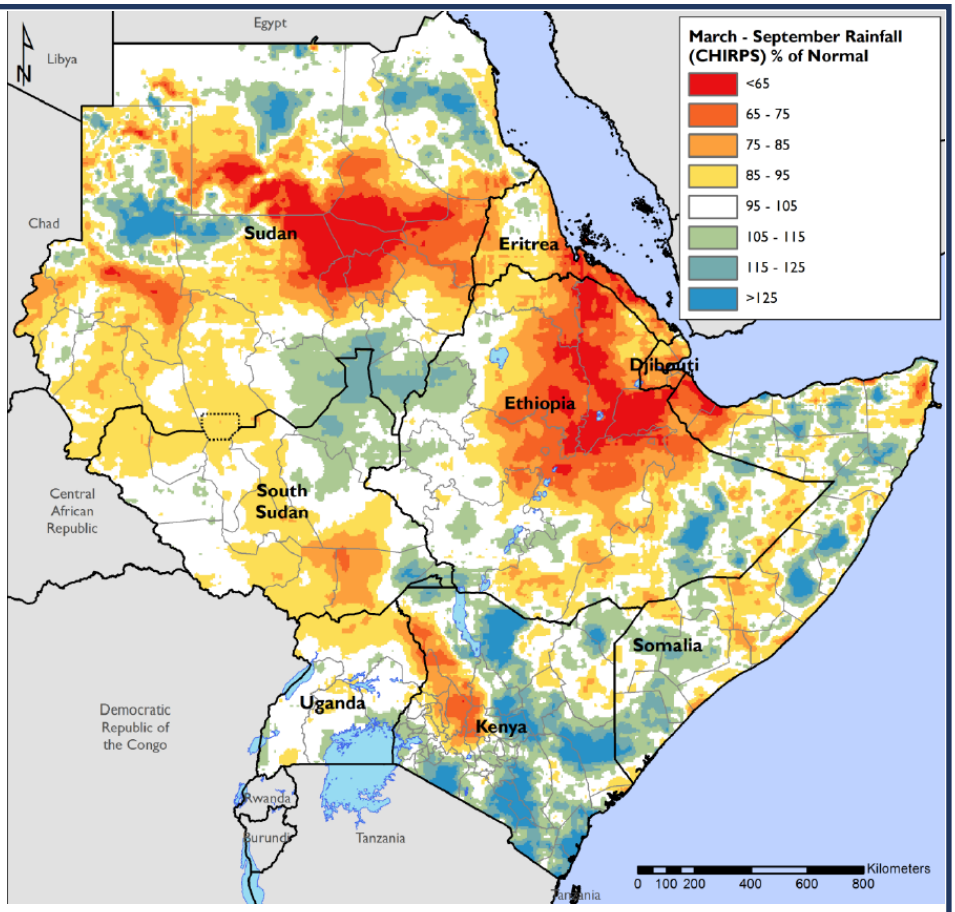


Fig. 3 March –September 2015 rainfall anomaly (% of the 1981-2014 average) for East Africa[32]

development of effective climate change adaptation plans." In case of an increase in the river flow, without good governance and management, it could lead to floods; in case of a decline due to rainfall anomalies (Fig. 3), it could lead to a water shortage. Another recent paper published in August 2019 in the *Earth's Future* journal predicts that countries like Ethiopia, South Sudan and Uganda may see a reduction in their water supplies, despite an increase in rainfall, due to climate change-driven hotter and drier years in the Nile basin which will cause most of the water that does fall to evaporate.[31] If this phenomenon comes to pass it will definitely cause rising concern for Sudan and Egypt.

Despite these challenges, there is still no agreement between Egypt and Ethiopia even after a meeting in Sochi, Russia, on October 23-24, 2019.[33] In fact, a statement by the Ethiopian prime minister two days before during a parliament question-and-answer session sparked a new set of tensions with Egypt. The prime minister Abiy Ahmed stated: "If there is a need to go to war, we could get millions readied. If some could fire a missile, others could use bombs. But that's not in the best interest of all of us." Despite the qualifying sentence at the end of the quote, the bellicose elements of the statement were made in an already very tense context. It was therefore extensively commented on in the press, and has contributed to increased tensions between the two countries.[34]

Again, the GERD case shows that cooperation and adaptation to future climate change will be a key issue in preventing tensions from escalating into conflicts, but that climate change could make such cooperation more and more difficult in te future. In the best-case scenario, increases in river flow and runoff could be used productively by states along the river and create new agricultural opportunities.[35] In an environment already strained by climate impacts, if downstream countries' perceptions feed suspicion towards upstream countries in a harsh climate change context, this could lead to misunderstanding and misinterpretation and, in worst-case scenarios, to conflict.

French Armed Forces transporting freight from the PIROI through PHA Tonnerre in Mayotte. Public Domain

MOZAMBIQUE: THE IDAI HURRICANE

What came to be known as the Idai hurricane appeared as a tropical depression on March 4, 2019, then became a tropical cyclone on March 11, and then reached its maximum intensity on March 14 and hit Madagascar, Mozambique, Malawi and Zimbabwe with winds around 200km/h. It was declared the deadliest cyclone ever recorded in the South-West Indian Ocean Basin and it killed more than 1,000 people with total property damage estimated at more than 2 billion dollars (1 billion of which was damage to infrastructure).[36] The disaster affected 3 million people and caused more than 10,000 cases of cholera or malaria.[37] The city of Beira, in the south of Mozambique, was reportedly 90% destroyed.[38]

Assessment of the disaster response showed that Mozambique's National Disasters Management Institute was not able to manage the scale of the event, or effectively harness regional and international cooperation. Even with accurate meteorological predictions, government and local authorities were not able to react efficiently enough (for instance, "areas which were heavily affected not receiving interventions were flagged as an overall challenge primarily due to limited accessibility")[39]. International assistance came from different organizations (International Federation of Red Cross and Red Crescent Societies, notably the Indian Ocean Regional Intervention Platform – PIROI), countries and actors (civil, humanitarian and military). Among many, the Southern African Development Community (SADC) launched a regional appeal in response to Idai on the 11th of April. Several countries supported the response mobilizing their armed forces and materials. The Indian Navy sent three ships to Port Beira to provide humanitarian and technical assistance; four Morocco Royal Armed Forces aircraft delivered 39 tons of tents and blankets; French Armed Forces used their La Réunion, Djibouti and Mayotte bases and reassigned the Landing Helicopter Dock (LHD) Tonnerre to assist in the response as the ship was conducting an exercise in the Indian Ocean. Assessment work is still being conducted in the area to inform the recovery activities that will continue for years to come.

In its tragedy, Idai provided many lessons learned and illustrated the challenges of conducting disaster response and integrating assistance from international armed forces. First, it reminded us that having good relationships with the affected country is always important, as assisting nations must obtain the agreement of local authorities in order to deploy troops and military assets on their host nation's soil and maintain effective operations for the duration of their presence in the country. Second, it emphasized the crucial contribution of military capabilities in emergency situations (aerial reconnaissance for assessment of response planning, aerial transportation to reach inaccessible zones which require assistance, naval capabilities to transfer freight, etc.). Third, it highlighted the need for a reassessment of types of capabilities that will be necessary for future civilian security missions of the armed forces to include whether current equipment is well-adapted to the range of operations that are expected to be required in the coming decades, and whether nations are capable of addressing cascading effects of simultaneous disasters.

REGIONAL SECURITY INSTITUTIONS: RISKS AND RESPONSES

Most African countries' armed forces have significant gaps in their capability and capacity to ensure territorial control, further hindering their ability to confront holistic threats, such as climate change, among their many competing priorities. Hydrological events, such as droughts and floods, have been integrated for some decades into international and national resource-based conflict prevention plans. They have been, however, insufficiently deemed as potential climate change consequences. More broadly, climate change as a threat multiplier remains a barely recognized concept for national defense stakeholders. Therefore, regional and international organizations have focused first on encouraging national military systems to tackle disruptions through weather-related data collection improvement and population information. More recently, some regional security institutions have recognized the security dimension of climate change.[40]

As an example, since the African Union launched the Great Green Wall effort in 2007 (an effort aimed at stopping desertification and enabling the absorption of 250 million tons of CO_2 per year starting in 2030 through tree planting) most regional organizations have taken steps to respond to climate-related threats through weather surveillance improvement and early extreme weather event warning systems. The ClimDev (African Union), Economic Community of West African States Early Warning Mechanism (ECOWARN) and Conflict Early Warning and Response Mechanism (CEWARN) from the Intergovernmental Authority on Development – programs, detailed below, demonstrate a strong regional focus on water management and food security. Additional programs have come online directly aimed at securing a regional strategic food reserve (such as ECOWAS with the EU and the UN), and water sources (such as the Permanent Interstate Committee for Drought Control in the Sahel).[41]

Finally, CREWS (Climate Risk and Early Warning Systems), launched in 2015 during COP21 in Paris, reinforces climate warning systems and coordinates reaction management to extreme weather events among Small Islands Developing States and Least Developed Countries, many of which are in Africa. [42]This large program is a collaboration between the World Meteorological Organization (WMO), the World Bank and the Global Facility for Disaster Reduction and Recovery (GFDRR) and the United Nations Office for Disaster Risk Reduction (UNDRR).

THE AFRICAN UNION

For several years, a number of regional organizations like the African Union have been at work studying climate change impacts, forecasting, and documenting them. Indeed, in 2010, the African Union, the African Development Bank and the Economic Commission for Africa of the UN (CEA) jointly initiated the ClimDev Africa program, driving the effective integration and computation of meteorological data to support the coherence of sustainability policies in African countries.

In recent years, the African Union has strengthened its position and statements on climate change, recognizing climate change as going beyond extreme weather and representing a direct threat to security in Africa. The African Union, with its mandate of peacebuilding and development, has a critical role to play in highlighting climate change as a peace and security threat. The African Peace and Security Architecture Roadmap for 2016-2020[43] stresses climate change as one of many threats to peace and security. In 2018, Moussa Faki Mahamat, former foreign minister of Chad and president of the African Union Commission, during an address to the Economic Community of West African States (ECOWAS) and the Economic Community of Central African States (ECCAS) at a Joint Summit on Peace, Security, Terrorism and Violent Extremism in Lomé, Togo[44] cited climate change amongst the first factors fueling the persistence of insecurity in West Africa. The Peace and Security Council (PSC) of the African Union should initiate the systematic consideration of climate change as a threat multiplier. It held two sessions[45] on the interactions between climate change and security in 2019. In addition, the press statement of its 864th meeting, taking place in August 2019, underlined climate change and its consequences as a major challenge for its member states, especially its impacts on infrastructure and its exacerbation of forced displacements and inter-communal conflicts.[46] This statement also called on African states to advance "adaptation measures with a view to building resilience in the communities facing climate change."

OTHER REGIONAL ORGANIZATIONS

In order to arrive at a common strategy to tackle droughts and their consequences, East African countries joined forces in 1986 and established the Intergovernmental Authority for Development (IGAD). This authority brings together eight East African countries (Djibouti, Ethiopia, Eritrea, Kenya, Somalia, South Sudan and Uganda), around coordinated action for development and conflict prevention. In 1989, IGAD opened two centers for weather surveillance and drought prevention, in Nairobi (Kenya), and in Harare (Ethiopia). Its Conflict Early Warning and Response Mechanism (CEWARN) is an additional tool to prevent conflicts between pastoral and farming communities. [47]IGAD has also been working since 2018 on a protocol to enable freedom of movement for pastoral farmers between countries (Cf b.i.).

On the western side of Africa, in 2003, ECOWAS implemented its early warning system for conflict prevention, ECOWARN (Early Warning System Response Network).[48] This has been followed by different calls in subsequent years for integrating climate change in security fora for integrated conflict prevention approaches.[49] Notwithstanding these calls for action, no specific program from ECOWAS on climate security has yet been put forward.

In parallel, the Global Alliance for Resiliency (Alliance Globale pour la Résilience or AGIR) has been launched with the objective of fostering synergies and coordinating coherent action and efficient initiatives for resilience in 17 countries of West Africa and the Sahel. It works with existing networks such as the Network for Food Crisis Prevention and organizations such as ECOWAS and the West Africa Economic and Monetary Union.

Overall, although these programs are generally successful with regard to their technical and data collecting aspects, the data collected and recommendations made are unfortunately often not implemented and thus do not directly impact decision makers; the information is available but does not seem efficiently exploited by relevant bodies or organizations.

UN MISSIONS AND OFFICES: MINUSMA BOURGOUTIÈRE CONFERENCE

Bourgoutières, or bourgou fields, are specific Sahelian wetlands critical for herders, fishermen and farmers. Recent conflicts arose from farmers' appropriation of lands previously dedicated to cattle grazing, leading to deadly confrontations over the last two decades. The Conference on Bourgoutières, organized by Mopti local authorities in 2015, was a turning point.[50] Through the involvement of MINUSMA, its funding, and the participation of its civil affairs department and the head of its regional office, conference participants, which included MINUSMA, administrative authorities, politicians, local workers' unions and governments as well as traditional authorities (dioros), agreed on 19 recommendations highlighting the importance of bourgoutières for herders, and the necessity to conserve them and reinforce the establishment of the 29 designated herding points near Mopti. Unfortunately, regional security conditions have worsened since the conference, making it difficult for authorities to implement these measures and to organize any follow-on conferences. This conference was nonetheless a success in that it enabled MINUSMA to step in and work with regional and local stakeholders on the bourgoutières' issues.

UNITED NATIONS OFFICE FOR WEST AFRICA AND THE SAHEL (UNOWAS)

UNOWAS has acted as a spokesperson for the importance of climate security in Africa in several international fora. In 2016, Mohamed Ibn Chambas, Special Representative of the United Nations Secretary General for West Africa and the Sahel, briefed the UN Security Council on the impact of climate change on peace and security in the region. His statement outlined the urgency of addressing climate change, to stop the deterioration of living conditions in the Sahel, near Lake Chad and along the coasts, as well as to stop the depletion of herding zones and fish stocks.[51] Also, during a recent conference on the role of defense and security forces in the prevention and management of intercommunal violence in West Africa and the Sahel (October 24, 2019, in Dakar, Senegal) he again highlighted the need for a holistic approach, which includes taking into account climate conditions, in addressing inter-communal violence. Tackling climate change at the global scale has been presented as a necessary step to limit the spread of inter communal conflicts.[52]

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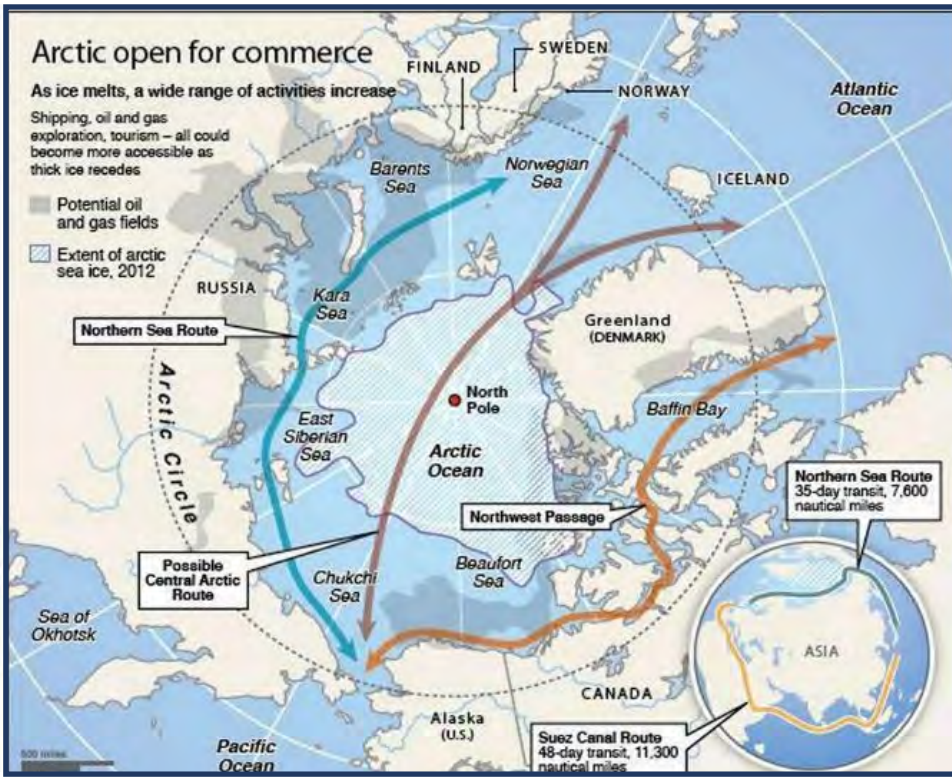
ARCTIC

THE BROAD REGIONAL PICTURE OF CLIMATE SECURITY RISKS



The Arctic is melting rapidly, revealing new trade routes and rich natural resources that are literally changing the security landscape. The receding ice cap promises a wealth of economic opportunities including untapped fishing stocks, massive oil and gas reserves, eco-tourism, and more profitable international shipping alternatives. Yet, this emerging bounty falls within a complex, multiparty web of contested territorial waters and exclusive economic zones, inevitably inviting strategic competition, security posturing and potential confrontation.

The Arctic is warming nearly twice as fast as the rest of the planet with consecutive record-breaking warm years since 2014.[1] For the first time in recorded history, Alaska experienced an average temperature above freezing for 2019. The Arctic is likely to begin experiencing ice-free summers within the next decade, with summers likely to be completely free of sea ice by mid-century, opening up new territory for shipping lanes and resource extraction.[2]

Fires have occurred across the Arctic Circle – Siberia, Alaska and Scandinavia, affecting permafrost that holds vast amounts of greenhouse gases – both methane and CO_2. Many scientists have long seen the Arctic and Antarctic as the most likely source of cascading tipping points for accelerated, catastrophic climate consequences. Continued melting of the ice cape may weaken the jet stream.[3]

Indigenous communities in the Arctic have been confronting the effects of climate change already. Coastal erosion has forced the dislocation of villages and thawing permafrost has disrupted traditional ways of life. Arctic states committed to enhancing the resilience of these communities must dedicate resources to protect and support isolated indigenous citizenry residing on an especially unforgiving edge of the climate change front.

The near term opening of the Arctic presents an immediate safety challenge driven by increased fishing, tourism and other commercial activity. The extreme conditions and lack of permanent security infrastructure necessitate search and rescue capabilities, ice breaking assets and the infrastructure to support them. Norwegian PM Solberg expressed this need for increased search and rescue capacity to

meet public safety concerns as a more pressing requirement than any near-term concern she has over hard security threats to Norway from the opening of the Arctic.[4]

Arctic players are recognizing that the likelihood of medium-term security competition requires immediate planning. The Russians have a long history and intimate familiarity with military operations in the Arctic. Their military infrastructure and support capacity is mature and extensive, particularly those associated with the Russian Navy's Arctic Fleet. The Russian military continues to press its advantage in the Arctic, upgrading its bases along the Northern Sea Route, preparing to launch its first weaponized icebreaker in 2023, and hosting an icebreaker fleet that is significantly larger than that of other Arctic nations.[5]

Those Arctic powers seeking to engage Russia's Arctic advantage in the military sphere have begun the long and costly process of fielding the types of naval combatants, aircraft and weapon systems that can withstand routine operations in ice, harsh seas and winds, and extremely low temperatures. They are also contemplating the scope, scale and cost of creating the infrastructure, communications, and logistics wherewithal required to operate consistently and effectively in the Arctic region.

SUB-REGIONAL DISTINCTIONS

GREAT POWERS AND COMPETING TERRITORIAL CLAIMS

A number of states are responding to one of the most dramatic and consequential drivers of climate change consequences around the globe—the melting of the Arctic—not by increasing cooperation on addressing climate change, but rather by maneuvering for geostrategic advantage.[6] Great powers Russia, the U.S., and China all see the Arctic area as a top priority - not only to compete for fish, oil, gas, rare earth metals and shipping routes, but also to establish a strategic security footprint to defend their respective interests. The U.S. Department of Defense Arctic Strategy released in July 2019 does not mention climate change but does present a strategy in which the "end-state for the Arctic is a secure and stable region in which U.S. national security interests are safeguarded."[7] The EU is still reluctant to emphasize the security dimension of the region, but with the new European Commission President intent on a more geopolitically active EU, this may shift in 2020.

Russia and Canada consider the Northern Route and North-West Passage to be national waters in which they can charge revenues for maritime passage. Those claims are not acceptable to the U.S. and others. The Northern Sea Route running along Russia's shallow coastline could cut up to 15 days off the current route from China to Europe via the Suez Canal and the Strait of Malacca. China has already invested in new harbors being developed along the Northern Sea Route. China also is deepening its Arctic presence through foreign direct investment in several Northern European Arctic States.[8]

In January 2018, in its first public Arctic policy, China declared itself to be a "near Arctic State," and articulated its intention to build a "Polar Silk Road" that will stretch from Shanghai to Hamburg, first across the Northern Sea Route, and later, across the central Arctic Ocean.[9] Vessels transiting the even shorter Transpolar Sea Route when the northernmost Arctic becomes accessible in a few decades will be able to avoid Russian and Canadian controlled waters. As Li Zhenfu, director of Dalian Maritime University's research Center for Polar Maritime studies, noted, "[w]hoever has control over the Arctic route will control the new passage of world economics."[10]

Multiple territorial claims have been submitted to the Commission on Arctic Shelves of the United Nations Convention on the Law of the Sea (UNCLOS). Canada, Denmark and Russia have the most extensive claims seeking extension of their continental shelves to encompass most of the Arctic Sea. A verdict is not expected until the end of the decade and, with the US not having ratified UNCLOS, it's unclear to what extent countries will feel bound to the ruling.

The great powers have a growing interest in Greenland given its geostrategic position and emerging access to rare earth metals and uranium. The U.S. Coast Guard estimates the Arctic holds 13% of the world's undiscovered oil, a third of the world's undiscovered gas and over one trillion in U.S. dollars in gold, platinum and other minerals.[11]

These dynamics of increased military and economic activity lay the groundwork for future tensions between Arctic nations, and in the absence of mitigating institutions and political will, may increase the likelihood of conflict between great powers.

REGIONAL SECURITY INSTITUTIONS: RISKS AND RESPONSES

The Arctic Council, a governance body made up of all eight Arctic states and an important multilateral mechanism for collaboration, is under stress.[12] Explicitly not tasked with security matters, the Arctic Council has successfully focused on environmental cooperation for over 20 years. U.S. Secretary of State Pompeo's statement before the Arctic Council meeting of May 2019 challenged the two leading assumptions underpinning this body: he hailed climate change as an economic opportunity rather than a threat and called the Arctic an arena for power and competition rather than science and cooperation.[13] In 2019, due to disagreements on climate change, the Arctic Council was unable, for the first time since its founding in 1996, to agree to a joint statement on the issue it was founded to tackle.[14]

A view of the decommissioned, Cold War-era "White Alice" communications station as seen from the Tin City Long Range Radar Site in Alaska. U.S. Dept. of Defense photo by Senior Chief Petty Officer Brandon Raile.

European Arctic powers (Denmark, Finland, Norway, Sweden), together with the EU, seek to maintain the stable status quo by emphasizing areas of broader consensus such as climate change mitigation, scientific cooperation and environmental protection. Despite this effort to depoliticize rising competition in the Arctic, debate has begun on possible mechanisms to address security issues in a manner that includes all relevant powers.

A less prominent body, but one with a broader security mandate, is the Arctic Security Forces Roundtable (ASFR), a semi-annual convening tasked mainly with improving maritime domain awareness and communication within the Arctic Circle. The meetings are attended by Canada, Denmark, Finland, France, Germany, Iceland, the Netherlands, Norway, Sweden, the United Kingdom and the United States. Russia used to take part, but has not been invited since 2014, after its decision to invade Crimea and eastern Ukraine. China is not involved either and has recently announced it is considering establishing a new platform for Arctic dialogue. In 2020 the EU is expected to publish a new Arctic strategy in which security may become more central.

Another entity that is grappling with a changing region is the Arctic Coast Guard Forum, a gathering of the coast guards of the eight Arctic nations, described as a "bridge between diplomacy and operations." The ability of the participants of this group to conduct exercises and operations, and to coordinate emergency response, will likely grow ever more useful.

Dynamics between NATO member states inhibit a more thorough consideration of the Alliance's role in a climate-changed Arctic. The Arctic security competition involves not only its members but also the Alliance's biggest potential adversary. Ambitions over the resources and sea lanes resulting from climatic change, as well as related overlapping territorial claims, already result in tensions between NATO allies (i.e. Canada and Denmark) as well as between NATO Allies and Russia.

As fish stocks migrate into warming Arctic waters, The Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean signed in 2018 by multiple nations, including the US, China and Russia, is also an important institution in terms of addressing knowledge gaps required to ensure sustainable management of an emerging fishery in this long inaccessible area.[15]

The Tin City Long Range Radar Site sits atop a mountain at the Bering Strait in Alaska.
U.S. Dept. of Defense / Senior Chief Petty Officer Brandon Raile

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EUROPE

THE BROAD REGIONAL PICTURE OF CLIMATE SECURITY RISKS

The European Union (EU), its Member States and European nations outside the EU, have long been frontrunners in advocating for action on climate change and security, both internally and on the international stage. The EU recognized climate change as a threat multiplier in 2008, its members states brought the issue to the UN Security Council at the same time, and in 2018, the EU stepped up its efforts to translate the concept into policy. The EU's earlier efforts to integrate climate change into development and foreign policy included an extensive climate diplomacy action plan. [1] The EU also integrated climate change into its early warning and early action policy. Following climate and security discussions at the Defense Minister level in 2019, the EU is expected to publish a climate-security paper directed at its member militaries. The paper may address both how to deal with climate impacts at home and abroad, as well as how to tackle armed forces contributions to greenhouse gas emissions.

European public engagement efforts to build public awareness on climate change have not normally focused on climate security implications, but rather, economic opportunity narratives. Perhaps as a result, many Europeans view climate risks as mainly affecting regions surrounding Europe (the so-called "ring of instability") rather than Europe itself. In reality, heat impacts, flood risks and forest fires are also a direct risk to the European continent, and risks to its neighborhood (the Middle East and North Africa, for example) have clear implications for social and political stability in the European subcontinent.

Although no region of Europe has been spared, climate change dynamics are impacting the continent unevenly due to both differences in geography as well as policies and capabilities. Southern Europe, and the Mediterranean in particular, is seeing decreasing precipitation and rising temperatures bringing extended drought conditions and hampering economic productivity. Western Europe is ranked alongside North America as being more resilient than Southern Europe/ the Mediterranean, but this does not take into account how significant outside climate-related pressures could be on political stability (e.g. the knock-on effects to North and Western Europe of climate-exacerbated stress to Southern Europe/ the Mediterranean and its broader neighborhood.[2] Several near-term, negative trends across Europe are poised to be reinforced by climate stress. Growing economic inequality, aging societies, high youth unemployment, aging populations, and stagnant economic growth is widespread but especially acute in the Mediterranean and Eastern Europe.[3] Inclusive climate policies that take into account growing inequality may help address troubling trends such as the radicalization of restless youth populations that is of growing concern for European governments.

THE EUROPEAN UNION

The EU Council in its statement in June 2019 acknowledged the "relevance of environmental issues and climate change for Common Security and Defense Policy (CSDP) missions and operations, including their impact on military capability planning and development in relation to the climate-security nexus."[4] The Council called for enhanced cooperation among stakeholders. Further, in its

January 2020 Conclusions on Climate Diplomacy, the EU Council stated:

> *"[The EU Council] is acutely aware that climate change multiplies threats to international stability and security in particular affecting those in most fragile and vulnerable situations, reinforcing environmental pressures and disaster risk, contributing to the loss of livelihoods and forcing the displacement of people. The High Representative, Commission and Member States will continue to take climate and environmental factors and risks, including on water, into account in our strategic engagement with partner countries and work on preventive measures such as early warning systems."*[5]

On June 22, 2018, the EU High Representative of the European Union for Foreign Affairs and Security Policy, Federica Mogherini, chaired a high-level meeting of the European External Action Service (EEAS) focused on climate change and security, wherein it was decided, among other actions, that the EU should "Elevate [the] climate-security nexus to highest political level in national, regional and multilateral fora."[6]

On August 29, 2019, Mogherini followed up on the 2018 meeting by chairing an informal meeting of EU Defence Ministers, which included a discussion on "the effect of climate change on defence and security." In her remarks after the meeting, Mogherini stated:

> *"In particular, we discussed with the Ministers two issues related to climate change and defence: one is how to make sure that the militaries contribute to address climate change issues, in particular reducing the energy dependency and its carbon footprint and in this way contributing to address climate change effects. That can also be helpful in terms of effectiveness and efficiency of operations on the ground. We also discussed the effect of climate change on conflicts, or on crisis areas that can affect the ways in which militaries could be deployed in these theatres. How can we foresee to adapt our capabilities, our way of working on the ground, in theatres where climate change creates situations that are different from the ones we have today. You can already see the connection present in some areas, in the Sahel for instance or other areas, where the militaries deployed – be they UN, NATO or EU or national militaries – have to face a situation on the ground that is evolving in terms of climate change conditions. We need to adapt our capacity to operate in these theatres"* [7]

CLIMATE-RELATED MIGRATION

Europe's leading climate security concern at home is migration, even though experts are keen to underline the difficulty of attributing migration to Europe to climate change, and to emphasize Europe's need for migrants in light of its aging population. The preponderance of intra-regional migration is often one directional, with residents from Eastern states like Bulgaria and Romania emigrating West and North in large numbers. This is alongside an influx of refugees from climate and conflict-impacted countries of Africa and the Middle East, as European and non-European citizens alike search for reliable economic

Syrians and Iraq refugees arrive at Skala Sykamias Lesvos Greece. October 2015. GGIA / WIKIMEDIA

opportunities and social safety nets in the regions' wealthy urban centers.[8] The European Union faced a severe political and security test during the 2015 migrant crisis. Such crises have increased the strength of political forces encouraging anti-immigrant sentiments, that many argue are at the root of the United Kingdom voting to leave the EU, stripping the bloc of a member with important security capabilities.[9] The increase in nationalist and authoritarian political voices also represents a risk to the EU as a whole, which could have significant regional and global security consequences in the future.

Climate stresses to Europe and its neighboring regions – particularly North Africa and the Middle East – are likely to increase the scale, scope, and tempo of migration to Europe, which will likely contribute to ongoing political fragmentation. Perhaps the biggest implication of increasing migration waves could be an increase in ethno-nationalist political rhetoric and party representation, and militarized responses to migrants, as seen in recent crises.[10]

SUB-REGIONAL DISTINCTIONS

THE DUTCH MASTERS & THE FINGER IN THE DYKE

The Dutch are renowned for their ability to hold back the seas. Flooding has always been a threat to a country mostly situated below sea-level. Dutch dyke management is exceptional and its engineering firms have been summoned around the world to protect low-lying coastal areas. In an age of climate adaptation, Dutch water engineering is fast becoming the Netherlands' primary export.[11] However, dyke management is not an effective measure against climate-induced groundwater salinization. The higher sea-level rises from melting ice and thermal expansion, the saltier the groundwater in the Netherland's coastal provinces becomes. Salt water intrusion threatens Dutch agriculture — one of the Netherlands' key export sectors.[12] Rising sea levels also cause salt water to travel further up Holland's rivers causing severe problems for fresh water supplies and agriculture.[13] When rivers cannot drain into the sea, estuaries move inland. Rising sea level may require that the Netherlands military infrastructure

A 2012 forest fire in the Yugansky nature reserve in western Siberia. Tatiana Bulyonkova / WikiMedia

such as low-lying airfields be moved to higher-ground and naval bases to undergo adaptation measures.[14] The Hero of Haarlem, the famous story of a Dutch boy who saves his country by keeping his finger in the dyke, is a powerful metaphor for the search for solutions to new climate-induced security threats from the sea. Much will depend on the adaptation decisions taken in a country with a storied history of ingenuity in overcoming daunting environmental risks.

RUSSIA: JOINING GLOBAL CLIMATE ACTION FOR COMPETITIVE ADVANTAGE

As a Eurasian power and the world's largest country, Russia encompasses the wide array of climate challenges explored across the regional assessments in this report. Straddling half of the rapidly-warming Arctic region, Russia's average temperature is rising 2.5 times faster than the global average.[15] Like other nations around the globe, Russia is experiencing more frequent droughts, flooding, heat waves and fires. An extreme drought/ heat wave and wildfires in 2010, most likely precipitated by climate change,[16] decimated Russian wheat harvests (destroying an astonishing 1/3 of the country's cultivable land), and led President Vladimir Putin to ban all grain exports – driving up prices around the world, including in the Middle East and North Africa. Another troubling development unique to the High North and especially acute in Russia is the melting of the permafrost. Russia has built significant infrastructure on permafrost now threatened by rising temperatures. Vast networks of roads, bridges, factories and pipelines are all at risk. The release of vast amounts of greenhouse gases trapped within the permafrost will have staggering atmospheric consequences. Arctic and boreal permafrost contains 1440-1600 Gt of carbon. That carbon is released into the atmosphere when the permafrost melts, causing more warming.[17]

Nonetheless, Russia has been slow to act until recently. In 2020, the Russian government issued its first National Action Plan for the First Phase of Adaptation to Climate Change. The development comes on the heels of Russia's recent ratification of the Paris Agreement in October 2019. In the plan, the federal government pledges responsibility for the security of citizens impacted by the consequences of climate change. In July 2019, widespread fallout of unprecedented Siberian wildfires resulted in a national emergency. That same month, following the most devastating flooding in Siberia in a century, Putin declared Russia's increasing natural disasters as a direct result of climate change.[18] Not surprisingly, the new adaptation plan calls for improvements to the country's disaster monitoring and forecasting network.

Most significantly, the plan reveals a recognition of Russia's insufficient capacity to address the threat climate change poses to its economy. The Economist Intelligence Unit's climate change model predicts the Russian economy will be 3.3% smaller in 2050 due to insufficient institutional preparedness and effectiveness addressing climate change.[19] Russia's national action plan addresses this weakness with adaptation strategies for priority sectors to include energy, transportation, and agriculture. Until now, climate considerations appear to have had little influence in Russia's policy making, with significant climate change skepticism predominantly resident within Russia's politically powerful business community. In that context, the plan addresses opportunities where Russia has a competitive advantage to include increased productivity of boreal forests, resource access on the Arctic's continental shelf, and transportation opportunities in the opening Artic Sea.[20] The Arctic already contributes 20% of Russia's GDP, namely in the energy, industrials and mining sectors.[21] Putin intends to add transport to the list of leading Arctic commercial activities, having announced a goal to quadruple Arctic maritime shipping tonnage from 20 million tons to 80 million tons by 2024.[22] Putin portrays the Northern Sea Route as a future "global, competitive transport artery" that is "the key to the development of the Russian Arctic and the regions of the Far East."[23] Putin sees climate-enabled commercial opportunities beyond the Arctic. His emphasis on climate change at the annual gathering of global leaders at the Valdai Club in October 2019 coincided with Moscow's ratification of the Paris Agreement and prompted a discussion on Russia as a future "food and water superpower," with dubious pronouncements of Russia having the capacity to feed both Asia and Europe to help them survive the deepening climate crises.[24] By mid-century, as projected temperatures increase and droughts devastate many of the world's grain producing regions' ability to meet the increased food demands of an exploding global population, the potential creation of arable land in Russia's north, while potentially useful,[25] will likely be more than offset by significant climate change-exacerbated risks to Russia's existing grain yields, as seen during the 2010 drought and heat wave.[26]

REGIONAL SECURITY INSTITUTIONS: RISKS AND RESPONSES

EUROPE IN THE NORTH ATLANTIC TREATY ORGANIZATION (NATO)

The North Atlantic Treaty Organization (NATO) took a step towards engaging substantively on the climate and security issue at its NATO Engages Summit in London on December 3, 2019. During a discussion specifically on climate and security, Norwegian Prime Minister Erna Solberg argued NATO needs "more discussion on how important it is to stop climate change."[27] Ambassador Boris Ruge, Vice Chair of the Munich Security Conference, followed up with a detailed question on NATO's specific role and if it went beyond dealing with the fallout of climate change. In response, Solberg stressed the political power of NATO to spur action.

"What we really have to do," she said, "is [to] stop climate change [and] make sure that we invest now instead of having to invest a lot in the future to work on the damages. It is much less costly to prevent climate change than it will be to adapt to it on all levels of our society."[28]

Solberg also saw a critical role for the military side of the Alliance: "I think NATO's role is to make sure that they analyze the root causes for changes in security in different areas," due to climate change, Solberg argued "climate change will lead to more migration. It will lead to more conflicts. It will lead to less sustainable development in all of the African continent, even though, on the soft-power side the European Union is trying to work together with [these] countries to create more development to stop the migration waves."[29]

Analytical assessments originating in the defense side of NATO that reveal where the climate change-related threats are coming from, and that assess military impacts resulting from climate-degraded security, are a logical next step for the Alliance. Further, NATO may play a role in encouraging Europe's leadership to guard against nationalist-driven divisions within the Alliance that could change the nature of the NATO mission, and potentially limit its ability to operate outside of the European subcontinent.[30]

Further, NATO's military infrastructure positioned strategically across both Western and Eastern Europe, as well as elsewhere, is at risk from climate change. Military installations along the Mediterranean and Atlantic are facing sea level rise and increased flooding incidents that will further impact systems, personnel, and force readiness.[31] NATO will also require further emergency response planning for increased extreme climate events in Europe to include heat waves and flooding, in order to build the capacity of the Euro-Atlantic Disaster Response Coordination Center, NATO Response Force, and the Crisis Management and Disaster Response Centre of Excellence (CMDR COE).[32] These steps will be costly. An organization renowned for its disputes over financial contributions and burden-sharing will be hard pressed to agree on the high costs demanded by adaptation investments in NATO's force readiness, as well as large-scale base infrastructure projects in response to emerging climate threats. Nonetheless, the benefits of early, collaborative action would outweigh the costs.

NATO Leaders at the December 2019 summit in London. U.S. Embassy in U.K. / WikiMedia

RECENT EUROPEAN EFFORTS AT THE UNITED NATIONS SECURITY COUNCIL

Following many years of calls by small island states, European nations have begun leading on climate and security action at the United Nations Security Council. Sweden, Germany and the Netherlands have all pushed for greater Council consideration of the issue and have worked with the United Nations Secretariat to build climate security capacity. In July 2020, Germany will assume its month-long presidency of the Council and is expected to bring forward the climate security agenda as part of its program of work. Fellow European council member Belgium is expected to fully support the initiative and also advance the politically sensitive debate on geo-engineering.

On January 20, 2020, The Council of the European Union adopted its Conclusions on Climate Diplomacy that called on the the UN Security Council (UNSC) and the United Nations

> *"…to create a comprehensive information basis for the UNSC on climate-related security risks, to fully integrate short and long-term climate and environmental risk factors in the assessment and management of threats to peace and security, at country, regional and international levels, and to draw on the expertise of the whole UN system in order to find operational responses to these risks and strengthen UN missions on the ground."*[33]

In 2019, Switzerland was unsuccessful in its effort to place geo-engineering on the UN Environment agenda. It had submitted a draft UN resolution calling for a UN-led examination of the risks of climate manipulating technology as a step towards stronger global oversight of potentially world-altering experiments that would have implications for the global food supply and security.[34] Little strategic analysis has been undertaken on geo-engineering, a significant potential climate mitigation security risk. Geo-engineering is the deliberate and large-scale intervention in the Earth's natural systems to either remove greenhouse gases or reflect a portion of the sun's solar energy known as solar radiation management (SRM). Little data exists on the extent to which countries, or non-state actors, are considering or planning such options despite the potentially dangerous longer-term and global effects. Global data sharing and archiving is needed to establish effective multilateral governance of emerging climate technologies. The report did not find evidence of armed forces pursuing programs or even seriously considering the risks of geo-engineering, and, significantly, there are no national or international governance or oversight mechanisms currently in place.

On January 25, 2019, the Dominican Republic[35] and a number of European countries (among them France, the UK, Germany, Peru, Poland and Belgium) called for the UNSC to establish increased analytical capacities for addressing climate risks to international security, such as a "clearing house" for data and information, including an early warning system and an annual report on climate and security to be delivered by the UN Secretary General to the UNSC. The open debate came on the heels of two years of significant attention to climate and security at the UNSC, including the launch of a Group of Friends of Climate and Security by Germany and Nauru in August 2018 (which included 40 nations at time of writing)[36], a June 2018 resolution on Mali,[37] an open debate hosted by Sweden on July 2018,[38] a resolution on the conflict in Somalia adopted in March 2018,[39] an Arria Formula dialogue chaired by Italy with participation from the Center for Climate and Security (and co-hosted by Sweden, Morocco, the UK, the Netherlands, Peru, Japan, France, the Maldives and Germany) in December 2017,[40] and a resolution on the Lake Chad Basin adopted in March 2017.[41]

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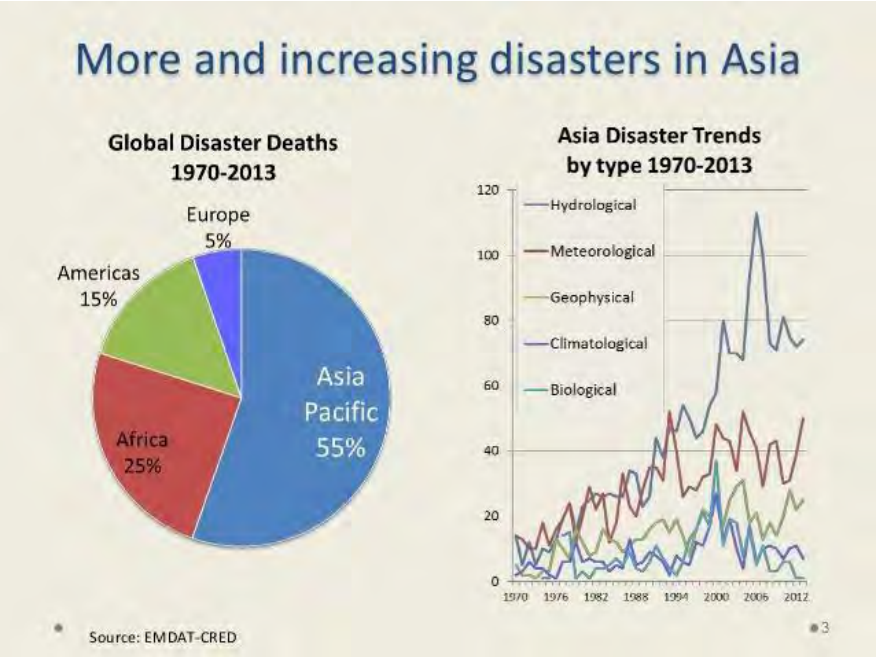
INDO-ASIA PACIFIC

THE BROAD REGIONAL PICTURE OF CLIMATE SECURITY RISKS

The vast Indo-Asia Pacific region is on the front lines of combating acute climate change challenges contributing to instability, migration and conflict. The fact that the Indo-Asia Pacific is the world's most natural disaster-prone region makes it particularly vulnerable. The region faces large-scale involuntary migration from extreme weather events. Dense populations near the coast face displacement, particularly in the Asia-Pacific "disaster alley." In 2018, extreme weather displaced over six million residents in five southeast Asian nations with over half displaced in the Philippines. [1]Asia's rising powers are the economic engine of the global economy, and responsible for over 50% of global greenhouse emissions. Across the Indo-Asia Pacific, populations are rapidly growing, urbanizing and industrializing.



Source: EMDAT-CRED, graph created by Vinod Thomas, Asian Development Bank

Changes in the oceans pose a particular security threat to the Indo-Asia Pacific. The region's coastal megacities and its far-flung island nations are highly vulnerable to sea level rise, storm surge and saltwater intrusion into freshwater aquifers. Pacific and Indian Ocean island nations face an existential struggle for survival against rising seas. Many face literally being erased from the map.[2] Tens of millions residing less than a meter above sea level in the region's coastal megacities such as Mumbai, Bangkok, Jakarta, and Ho Chi Minh City, face the same uncertain future.[3] Pacific and Asian populations often depend on fishing for the bulk of their diet and income, and are likely to see increased vulnerability as warming increases.[4] The region is experiencing ocean acidification, and rising temperatures are collapsing fisheries and altering migratory routes of economically vital fish.[5] The rapid depletion of fish stocks is already impacting the food security of the Asia Pacific, and contributing to inter-state tensions in the South China Sea.[6]

In Central Asia, melting Himalayan glaciers pose a grave threat to the freshwater supply for billions of people. The region is home to unstable states and international terror groups that make nuclear proliferation a particular concern. This confluence of strategic risks could have significant regional and global security implications.[7]

Central Asia is heavily reliant on climate-sensitive rural economic activity such as rain-dependent agriculture and pastoralism, making populations especially vulnerable to droughts, floods, and other natural disasters. As in other regions, the impacts of a warming climate on water security, food production, and the intensity of natural disasters in Central Asia is contributing to poverty and the displacement of rural residents to urban centers. Melting glaciers present a significant flooding threat, and floods as destructive as the 2010 deluge that impacted nearly 20 million Pakistanis are projected to become more routine.[8] Chronic conflict in countries such as Afghanistan and Pakistan has exacerbated vulnerability to climate stress, the impacts of which, in turn, help to create the conditions for continued violence.

SUB-REGIONAL DISTINCTIONS

AFGHANISTAN: A CONFLUENCE OF RISKS

The security consequences of climate change are already manifesting in Afghanistan.[9] Afghanistan is ranked 26th most vulnerable nation in the 2019 Climate Risk Index, which assesses the level of exposure and vulnerability to extreme events.[10] The geographic and topographical environment of Afghanistan predisposes millions of Afghans to natural hazards such as floods, droughts, avalanches, and landslides, a plight exacerbated by the impacts of climate change.

A critical reliance of over 80% of the population on rain-fed agriculture and livestock herding exacerbates Afghans' precarious susceptibility to fluctuations in the climate. Pronounced changes in rain and snowmelt patterns (heavy rainfall has increased up to 25% over the past 30 years)[11] have made flash flooding and runoff more pronounced. Paradoxically, these changes have led to drier conditions and increased drought, which has degraded the agricultural foundation of the Afghan economy.

Forty years of internal conflict and governance dysfunction are an equally important driver of Afghanistan's vulnerability. Conflict has damaged or destroyed large portions of the country's transportation and energy infrastructure and led to widespread deforestation.[12] Critical water infrastructure has been destroyed or has fallen into disrepair leaving Afghanistan with the lowest per capita water storage capacity in the region.[13] Afghanistan suffers significant community and inter-ethnic violent conflict over access to land, pastoral grazing rights and irrigation water. Armed opposition groups will likely further take advantage of these disputes as climate change makes them more acute.

THREE SPECIFIC AFGHANISTAN CLIMATE SECURITY TRENDS TO WATCH

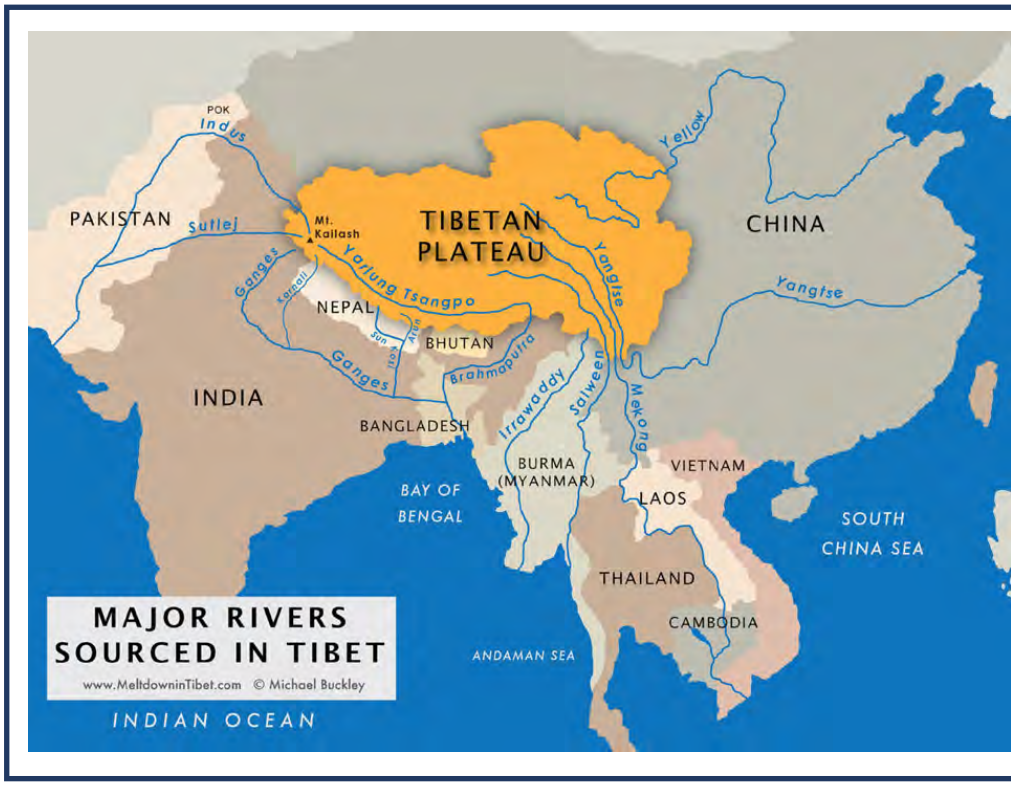
RESILIENT DRUG TRADE. As the world's number one opium producer, Afghanistan's drug trade stands to further benefit from a drought-resilient, water-efficient, and highly lucrative poppy crop well-suited for projected climate changes. Farmers, armed opposition groups, and corrupt government officials will be further incentivized to oppose central government authority in drug-producing areas.[14]

TRANSBOUNDARY WATER INTRIGUE. Decades of war have not allowed the construction of adequate water-related storage infrastructure in Afghanistan to harness its five great rivers. Afghanistan's regional neighbors have benefited from the largely unimpeded discharge of these five rivers into their territories. As disappearing mountain snows and chronic drought deplete critical water supplies throughout the region, neighbors may consider "peace spoiler" gambits as a means to forestall Kabul's investment in its water infrastructure.[15]

THE RESOURCE CURSE. Afghanistan has large reserves of lithium and a range of other minerals that are highly sought after in the renewable energy storage revolution. A country long devoid of abundant natural resources, Afghanistan could accrue tremendous economic benefit from supplying the growing global demand for lithium, for example.[16] Alternatively, Afghanistan could fall prey to the so-called "resource curse" associated with countries rich in natural resources that experience significantly less economic growth, democracy and development progress than countries with far fewer natural resources. Afghanistan already suffers from these challenges in spades and will have to navigate carefully the growing strategic importance of lithium as a force for desperately needed economic development while not inviting increased conflict, corruption and environmental degradation.

THE TIBETAN PLATEAU: CRUMBLING WATER TOWER OF ASIA

The dramatic climate impacts unfolding on the Tibetan Plateau are manifesting in water crises throughout the Himalayan region and greater Asia. Tibet is often referred to as the Earth's "third pole," as after Antarctica and the Arctic, the Tibetan Plateau holds the third largest reserve of ice on the planet. Over the past 100 years, 50% of Tibet's glaciers have melted. Melting has led to severe flooding, avalanches, and landslides. Conservative projections indicate that at least 33% of Tibet's remaining 46,000 glaciers will disappear over the next 75 years.[17] That ice is the source of Asia's ten major rivers supporting almost two billion people, many living on an immense arc of coastal river



deltas reaching from the Arabian Sea (Indus), Bay of Bengal (Ganges, Brahmaputra), South China Sea (Mekong), East China Sea (Yangtze) and culminating as far north as the Bohai Gulf (Yellow). The more arid regions in Northern China are facing growing water insecurity, as demand from industrial cities grows and flow rates from the Yellow, Yangtze, and Mekong rivers decline.[18] The stresses of climate change are exacerbating disputes that can turn dams and canals into sources of conflict. No water treaties exist between China, India and Bangladesh. In the face of that, there is a growing realization amongst downstream nations that China is developing formidable engineering and technical capacities to divert critical regional water supplies for its own growing needs. [19] For example, New Delhi and Dhaka harbor serious security concerns that China has long term designs to divert water from the Yarling Tsangpo River in southern Tibet (which turns into the Brahmaputra once it enters India) to the vast Taklamakan desert in Xinjiang.[20] Chinese engineers are testing techniques that may be used to build a 1,000 km tunnel intended to transform the barren Taklamakan into a breadbasket rivaling California's Central Valley, with serious consequences for Northeast India and Bangladesh. Such an audacious and destabilizing move would be met with serious opposition from India, Bangladesh[21] and the international community, potentially sparking regional conflict.

SECURITY INFRASTRUCTURE AND SEA LEVEL RISE: TURNING THE TIDE

The United States is an Asia Pacific nation with critical security architecture based on its territories, possessions, as well as with its Compact of Free Association (COFA) partners and regional allies. Many U.S. military installations are threatened by climate change, with those on Diego Garcia and the Marshall Islands especially exposed to sea level rise and saltwater intrusion into freshwater.[22]

Ronald Reagan Ballistic Missile Defense Test Site at Kwajalein Atoll, Republic of the Marshall Islands. Public Domain

The destructiveness of rising seas is an everyday worry for inhabitants of the Republic of the Marshall Islands, who have experienced seas that have risen over a foot in the past 30 years, faster than anywhere else on Earth.[23] The Marshall Islands brought international attention to the existential threat of sea level rise by declaring a national emergency in 2013 due to severe drought accompanied by rising seas. The United States military, with the help of several thousand civilian contractors, operates several

strategic national security capabilities in the Marshall Islands, a COFA state. Space Fence, a $1 billion U.S. Air Force space object tracking radar critical for keeping astronauts and satellites safe from space debris, was recently installed on Kwajalein Atoll despite warnings of inundation. A subsequent U.S. Geological Survey study, funded primarily by the U.S. Department of Defense (DoD), found that Kwajalein Atoll will be submerged by tide surge at least once annually in a few decades.[24] Dr. Curt Storlazzi, an oceanographer with the U.S. Geological Survey, led the study and stated that the underwater contours of the islands revealed how deadly bleaching of coral in warming waters smooths reefs, degrading their ability to absorb wave energy and serve as effective breakwaters.[25] Within the DoD, a growing awareness of climate change impacts on security operations and requirements is slowly turning the tide towards climate-resilient decision making.[26]

CLIMATE MIGRATION: PACIFIC CANARY IN THE COAL MINE

Kiribati, a vast Pacific island chain of tiny coral atolls barely two meters above sea level at their highest, is a nation facing an existential territorial crisis. In 2014, intent on the future survival of his nation, former Kiribati President Anote Tong purchased six thousand acres over 1,000 miles away on Fiji's second largest island.[27] The UN IPCC's 5th report made Kiribati's fate clear, stating that small islands in the Pacific and Indian oceans face total submergence. Low lying islands will be uninhabitable well before they slip under the sea due to acute coastal flooding and erosion resulting in saltwater intrusion into freshwater aquifers.[28] Tong stated, "The message was loud and clear: whether you believe it or not,

South Tarawa atoll in Kiribati, one of the most vulnerable nations to sea level rise. Public Domain

whether you are going to do anything about it or not, our fate is sealed. At some point within this century the water will be higher than the highest point in our lands."[29]

In 2013, Kiribati citizen Ioane Teitiota applied for asylum in New Zealand claiming that sea level rise put his family's lives at risk in Kiribati. On January 7, 2020, a landmark ruling by the UN Human Rights Committee stated it is unlawful under international law for governments to return people to countries where their lives might be threatened by the climate crisis.[30] Although the first of its kind judgment opens a path for future climate migrant claims, in this instance the UN Human Rights Committee upheld the decision of New Zealand's High Court to return Teitiota to Kiribati on the grounds that while "sea level rise is likely to render the Republic of Kiribati uninhabitable … the timeframe of 10 to 15 years could allow for intervening acts by the Republic of Kiribati, with the assistance of the international community, to take affirmative measures to protect and, where necessary, relocate its population."[31] As part of its argument, Kiribati stated that in "removing him to Kiribati, New Zealand violated his right to life under the Covenant. Sea level rise in Kiribati has resulted in: (a) the scarcity of habitable space, which has in turn caused violent land disputes that endanger [Teitiota's] life; and (b) environmental degradation, including saltwater contamination of the freshwater supply."[32]

Kiribati President Tong recognizes that the more he and others spread awareness of the existential threat climate change poses, the more citizens like Ioane Teitiota will want to leave their homeland. In an effort to ease this transition, Kiribati has created skills training programs to provide their youth an economic lifeline when they are forced to seek higher ground in a new land.[33] "Migration with dignity is a real strategy….they will go on merit. We will prepare them."[34] Whether or not the new communities they seek out for refuge will welcome them is an open question. Seventy-five million others around the globe who are living less than a meter above sea level, including in megacities such as Mumbai, Bangkok, Jakarta and Ho Chi Minh City, also face such an uncertain future, and the potential political and security implications of such mass displacements could be significant.

VIETNAM'S GREATEST CLIMATE SECURITY CHALLENGE: FAILING FISHERIES

Vietnam is a nation for which the sea is indispensable. The country's more than 2,000 miles of coastline and its extensive river systems make it vulnerable to sea level rise and saltwater intrusion into freshwater aquifers and arable lands. This is particularly the case in the Mekong River Delta, Vietnam's breadbasket, where a quarter of the population lives. The nation's biggest climate challenge is the impact on its fisheries. Vietnam's renowned aquaculture production is concentrated in the Mekong River Delta where sea level rise is causing saline intrusion into brackish and freshwater hatcheries, depleting yields.[35]

It is hard to overstate East Asia's global dominance in fisheries. China, Thailand and Vietnam, accounted for 80% of world fishery production in 2008 and 50% of fishery export value. Asian populations often depend on fishing for the bulk of their diet and income. It is equally hard to overstate Vietnamese reliance on fisheries.[36] A comprehensive study of the importance of fisheries to national economic and food security ranks Vietnam as the most sensitive country in the world.[37] Rising ocean acidification and temperature spikes are also contributing to collapsing reefs and fish stocks.

Migration of economically vital fish stocks into more northern waters claimed by China is an emerging security concern. Southeast Asia's open sea fisheries are located amidst a complex security environment featuring several overlapping maritime territorial claims. Vietnamese fishing vessels following the northward fish migration or reacting to fisheries depletion within their Exclusive Economic Zone (EEZ) risk confrontation with Chinese patrol vessels, inflaming existing maritime territorial disputes.[38] Escalating confrontation over fisheries in the South China Sea has led to violence in the past and always risks a wider regional security conflagration potentially involving the United States and others.[39]

AUSTRALIA AND NEW ZEALAND: CLIMATE SECURITY LEADERSHIP DOWN UNDER

The unprecedented wildfires in Australia, coming on the heels of Australia's hottest and driest year on record, have been the most recent climate-related catastrophes to capture the world's attention. The devastating fires are just the latest and most acute of many climate change challenges Australians have had to endure. To cope with the growing crisis, the Australian Cabinet's National Security Committee deployed the Australian Defense Force under the authority of its Australia's Defence Assistance to the Civil Community Arrangement. More than 6,500 ADF personnel are supporting Operation Bushfire Assist. The ADF is being supported by more than 300 regional military personnel from New Zealand, Papua New Guinea, Singapore and Japan.[40]

The extraordinary response to these wildfires could catalyze a sea change in how the Australian military and security institutions around the world prioritize and plan for the security consequences of climate change. The 2018 Australian Senate Report, Implications of Climate Change for Australia's National Security, was prescient not only in recognizing climate change as a "threat multiplier,"[41] but also as a "burden multiplier." [42] Although the "burden multiplier" moniker is a word image not likely to increase enthusiasm amongst security professionals, it is accurate and instructive. The report found that coping with the effects of climate change will "place additional stress on military resources, including ADF estate, personnel, support systems, facilities, supplies, collective training activities and command structures."[43] Australian Air Vice Marshal Hupfeld, Head Force Design, told the committee that climate change "can certainly directly affect Defence's operations, our bases, our infrastructure, our equipment and our personnel."[44] Further, as quoted in the Australian Senate Report on the implications of climate change for Australia's national security, in 2016, the Australian Chief of Army, Lieutenant General Angus Campbell DSC AM, stated in his address at the Chief of the Army's Exercise that as "weather events intensify we can reasonably expect to see the increasing use of Defence assets in support of humanitarian assistance and disaster relief (HADR) operations."[45]

The New Zealand Defense Force (NZDF) has also emerged as a leading military when it comes to "developing a clear strategic response to the climate emergency and promoting global recognition of climate change as a security risk."[46] The NZDF is taking a lead regional and international role advocating for climate security at the highest political-military levels and in security forums, including a climate seminar with its ASEAN counterparts later this year.[47] New Zealand Defence Minister Ron Mark recently made climate change and security a key element of his visit to Washington, DC.[48]

This includes the December 2019 release of "*Responding to the Climate Crisis: An Implementation Plan*," co-produced by the New Zealand Ministry of Defence and the NZDF.[49] Cooperation on climate and in particular humanitarian assistance/disaster relief will aid ASEAN's disaster management response initiative. New Zealand and its UN Mission in New York have supported PIF efforts to secure UN Security Council consideration of the climate and security issue. They have worked closely with the UN Secretariat to improve climate security capacity within the UN.[50]

The Australian and New Zealand militaries are increasingly called upon to respond to climate-related disasters both domestically and abroad. These missions not only compete with traditional security commitments and preparedness, but also present fundamental challenges to those charged with properly manning, training, and equipping their forces. Climate change impacts the readiness of armed forces in the region by disrupting carefully choreographed training, exercise, maintenance and deployment cycles and by diverting precious resources. The diverse set of skill sets required are not always easily interchangeable or transferable with traditional requirements. Effectively integrating climate change prevention and response into the way militaries operate, "will require new thinking about force structures, capability and equipment choices, and training and exercise regimes".[51]

REGIONAL SECURITY INSTITUTIONS: RISKS AND RESPONSES

The Indo-Asia Pacific as a whole does not benefit from a set of well-established security institutions or multilateral arrangements to deal with climate security issues, especially those manifesting around trade, territorial claims and migration. Pacific Island nations on the frontlines of climate change have initiated steps to rectify the institutional climate security vacuum.

In 2018, Pacific Islands Forum (PIF) leaders affirmed, through the *Boe Declaration on Regional Security*, that climate change is the single greatest threat facing the region. At their 50th meeting in Tuvalu in 2019, leaders issued the *Kainaki II Declaration for Urgent Climate Change Action Now*, the strongest statement the Pacific Islands Forum has ever issued collectively on climate change. The support of the Declaration from PIF's two largest and most influential members, Australia and New Zealand, adds considerable weight to the Pacific's negotiating priorities at the international level. Additionally, the region's militaries are starting to engage on the issue. In 2019, at the South Pacific Defense Ministers Meeting (SPDMM), military leaders met in Fiji and issued a communique acknowledging the 2018 Boe Declaration's affirmation that "climate change presents the single greatest threat to the livelihood, security and wellbeing of Pacific peoples," and recognizing climate change as a "challenge for which regional defence organizations must be ready".[52] The Defense Ministers explored defense force climate mitigation possibilities and accepted New Zealand's offer to hold a Climate Change and Defence Working Group Meeting in 2020 to assist member progress on climate and security. The SPDMM "emphasized the unique and important role of defense forces in dealing with climate change."

Over the past nine years, The Association of Southeast Asian Nations (ASEAN) Defense Ministers Meeting Plus (ADMM Plus) has quickly evolved into the principal forum for multilateral defense engagement in Asia. The Plus members include Australia, the United States, China, India, Japan, Russia, New Zealand and South Korea. Its 2019 Joint Declaration on Sustainable Security called

for a focus on non-traditional security threats to the region, but the forum has not addressed climate change directly. ADMM Plus should add climate and security as a key focus into its framework of seven Expert Working Groups (EWG) that cover issues from maritime security to counter-terrorism to cyber threats.

RISING SEAS AND UNCHARTED LEGAL WATERS

The UN Convention on the Law of the Sea (UNCLOS) and its three institutions: The International Tribunal for the Law of the Sea (ITLOS), the International Seabed Authority (ISA) and the Commission on the Limits of the Continental Shelf (CLCS) will be increasingly tested by competing ocean resource claims especially in the Indo-Asia Pacific. The status of legal maritime boundaries based on baseline territorial features are entirely uncertain if such features are submerged due to sea level rise or are declared uninhabitable under current legal definitions. The loss of sovereign terrestrial territory due to rising seas will have an enormous impact on national waters and exclusive economic zones (EEZ) over which a coastal or island state has special rights regarding the exploration and use of marine resources, including energy. In the Pacific, for example, the submergence of small outlying reefs and atolls in vast island nation archipelagos may result in the loss of hundreds of thousands of square miles of a nation's EEZ. Similar baseline controversies will arise in the already contested South and East China Seas.

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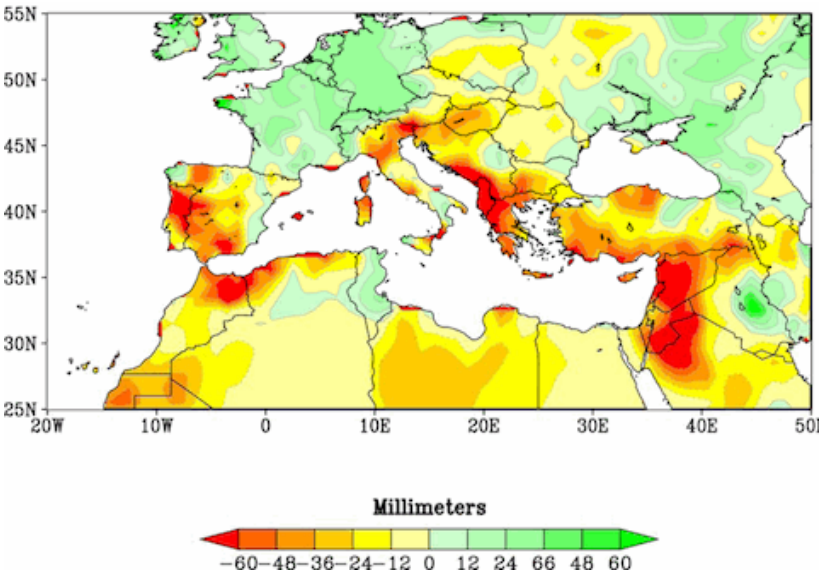
MIDDLE EAST

THE BROAD REGIONAL PICTURE OF CLIMATE SECURITY RISKS

The Middle East, already an arid region, faces significant precipitation decline and increasingly high temperatures as a result of climate change, which will further complicate the region's political instability. Extreme heat and chronic drought make the Middle East increasingly one of the driest regions on the planet. Summer temperatures across the region are expected to increase more than twice the global average, and winters – when the region receives most of its water – are projected to experience significant precipitation decline. Climate models predict prolonged heat waves, desertification, and droughts will make parts of the Middle East and North Africa uninhabitable within a few decades.[1] Where Middle Easterners will still be able to live, climate change may fuel violent competition over diminishing resources. Despite these grave dangers, governments in the region have not done enough to integrate climate change into their planning to mitigate instability and conflict.[2]

EXTREME DROUGHT AND WATER INSECURITY

In this already hot and arid region, temperature records have been repeatedly broken in recent years and are expected to continue to climb. The highest recorded temperature in the region to date was 54°C (129°F) at Mitribah, Kuwait in 2016. In the same week, Basra in Iraq recorded 53.9°C. In June 2017, Sweihan, Abu Dhabi reached a record high of 50.4°C. In Dubai, authorities warned drivers not to leave aerosols in their vehicles after several cars caught fire in the extreme heat.[3] In a 2016 study, researchers from Germany's Max Planck Institute for Chemistry found that by the middle of the century temperatures in some parts of the Middle East will have increased by 4°C,[4] with nighttime temperatures not dropping below 30°C, and with heat waves potentially occurring 10 times more than they do today.[5] In a statement accompanying the paper, Jos Lelieveld, director of the research institute, said, "Prolonged heat waves and desert dust storms can render some regions uninhabitable, which will surely contribute to the pressure to migrate."[6]



Parts of the region have also been subject to an almost continuous drought since 1998, according to NASA, which says the current dry period is the worst in the past 900 years.[7] Precipitation trends in the Middle East are alarming. NOAA data indicates a persistent, dramatic decline in winter precipitation, when the region receives the majority of its rainfall.

Reds and oranges highlight lands that experienced significantly drier winters during 1971-2010 than the comparison period of 1902-2010.[8]

Participants at the World Economic Forum on the Middle East and North Africa, held at the Dead Sea in Jordan in April 2019, could see the effects of global warming first-hand. The salt lake has shrunk by almost a third in the last two decades, due to lower rainfall, higher temperatures leading to increased evaporation, and water being siphoned off from the River Jordan, which flows into it.[9]

Water scarcity and the lack of sustainable water management are already having significant negative effects on both agriculture and drinking water.[10] The World Bank, which is spending $1.5 billion to fight climate change in the region, estimates that 80-100 million people will be exposed to water stress by 2025. According to a 2018 World Bank report on water security in the region, the Middle East and North Africa (MENA) is the world's most water-scarce region, with 17 countries below the water poverty line set by the United Nations. Water in the region is being withdrawn faster than it can be replenished.[11] Overall, the World Bank summed up the water situation in the region this way:

> *"Increasing consumption, paired with undervalued water, inadequate governance arrangements, and weak enforcement is leading to the depletion of water resources—especially groundwater—at an unprecedented rate. Unmanaged trade-offs in the water-energy-food nexus are also contributing to an overexploitation of water resources. Climate change poses another set of pressures on this rapidly evolving context. The negative impacts of climate change on water availability call for urgent action to allocate and use water more wisely. Climate change is also bringing about more frequent and severe climatic events. This will in turn increase drought and flood risks, which will harm the poor disproportionately"*[12]

Exploding population growth, migration and urbanization also increase demand for food and water while climate change hampers these resources. In Jordan, for example, the population more than doubled over the last twenty years,[13] drastically increasing water consumption— forcing the Kingdom to import water from neighboring Israel. The entire region is set to see high rates of population growth, about 2% annually, and particularly the expansion of cities, with the region's urban population expected to double by 2050, to nearly 400 million.[14] Food and water resources have been further strained by

Marsh Arabs poling a traditional mashoof in the marshes of southern Iraq. Hassan Janali / U.S. Army Corps of Engineers

the hundreds of thousands of refugees Jordan has welcomed from neighboring conflicts.[15] As reported by the UN in its 2019 World Water Development Report, water scarcity on a per person basis in the Arab region will continue to increase due to population growth and climate change. The challenge of ensuring access to water services for all under water-scarce conditions is exacerbated in conflict settings where water infrastructure has been damaged, destroyed and targeted for destruction.[16]

In addition to the challenges posed by the natural environment, and population growth, another layer of complexity is created by the fact that many states in the Middle East rely on water sources from outside their borders. Throughout the Middle East, historically weak water sharing arrangements are being tested as states contend for diminishing water supplies to support their rapidly growing populations. The Tigris and Euphrates Rivers originating in Turkey and crossing Syria, Iran, and Iraq, and the Jordan River traversing Jordan, the Golan Heights, Israel, and the West Bank are the two most significant waterways in the Middle East. Regional tensions are in part driven by suspicions of the long-term intentions of upstream neighbors to possibly dam, deplete, or constrain precious water resources. In Iraq, for example, upstream Turkey has built five dams on the Euphrates since the 1960s. That has cut the flow to Iraq by more than half, Hassan Janabi, a former Iraqi minister of water resources, told NBC News.[17] Rivers will shrink even more as the filling of Turkey's newest dam is set to cut water flows into Iraq further.[18] On the flip side, in an example of regional cooperation, the governments of Israel and Jordan have agreed to co-fund a pipeline bringing water from the Red Sea to the Dead Sea. Environmentalists fear that Red Sea water will harm the Dead Sea's delicate ecosystem, altering its salinity and even increasing evaporation. But unless action is taken, the sea will continue to shrink more than 1.2 metres every year.[19]

Intense competition for control over water resources has been a core driver of chronic tension in the Middle East conflicts. Israel's guaranteed access to water has long been a critical component of peace negotiations with the Syrians over control of the Golan Heights. It has also been central to negotiations over a Palestinian state. EcoPeace Middle East, a regional leader on the water security issue, has brought together Jordanians, Israelis and Palistinians to advance environmental peacebuilding through shared natural resources. Equitable allocation and efficient management of Israeli / Palestinian shared waters have been held hostage to lack of progress on other final status issues.[20] EcoPeace Middle East is building consensus around progress on water as a path to restore public trust that peace is possible. The success of its water security program has led to its widespread adoption beyond the Levant, and its water-energy nexus initiative is building climate adaptation and peacebuilding by connecting Jordanian renewable energy potential with Israel's desalination capacity.[21]

DETERIORATING LAND

The backdrop of aridity, limited cultivable land, scarce water resources, and the impacts of climate change combine to pose a bleak picture for food security in the region.[22] Population growth, rising demand for food, natural resource mismanagement, and dependence on volatile global food markets, have also contributed to food insecurity in the region.

Middle East societies are highly dependent on rain-fed, climate-sensitive agriculture and food imports.[23] Eight out of ten of the top wheat importing countries in the world are in the region. Droughts in grain producing areas of the world have contributed to sharp rises in food prices in these import- dependent states. In the Middle East, droughts and ensuing crop failures further exacerbate the region's high-dependence on agricultural imports. Food shortages have been credited with political instability and violence. Extreme drought impacting both the region and its trading partners served as an important contributor to the mass social unrest over food availability and prices that swept the region prior to the Arab Spring. Syria's extreme 2007-2010 drought, which was made 2 to 3 times more likely due to climate change, ultimately contributed to the displacement of 1.5-2 million people prior to the outbreak of its ongoing civil war.[24]

Small farmers play a major role in the Middle East region's food security. They produce the bulk of the region's domestic supply of staples. However, small farm holders are among the most vulnerable to the impacts of climate change in the region. Improving their resilience to climate-induced agriculture sector challenges is important not only to support their livelihoods, but also to protect food security throughout the Middle East and North Africa region.[25] The rain-fed farming systems are extremely vulnerable to the adverse impacts of climate change. Based on current projections, as global warming continues, it is expected that the MENA region will become drier with reduced and more unpredictable annual rainfall, and that more extreme weather events will become more frequent. More of the region's agricultural land areas would no longer be suitable for crop cultivation.[26] According to a 2014 report on food security by the Arab Forum for Environment and Development, agriculture has put immense pressure on the scarce water resources, including non-renewable groundwater. Specifically, about 85% of total water withdrawals are for agriculture, and irrigation systems are only about 46% efficient.[27]

According to Amal Kandeel, Director of the Climate Change, Environment and Human Security Program at the Middle East Institute, supporting currently viable small farm communities—to prevent both the deterioration of good productive land as well as the destabilization of livelihoods that depend on them—is crucial not just from an individual farmer's perspective, but also from a national perspective. Protecting productive small farmers from climate change pressures could help buffer their communities from economic distress and a consequent potential rise in social tensions and transgressions upon land rights. It could also curb rural migration to urban areas.[28] In a recent article the *Atlantic Council* agreed with these sentiments saying, "Climate adaptation projects targeted at the most climate and conflict-prone countries can go a long way in preventing violence-inducing scarcity before it occurs." The article recommends expanding Middle East projects under the UN's Green Climate Fund to focus on the climate resilience of water, riparian coastal resilience, and arid irrigated agriculture. It also recommends increasing funds for the CGIAR consortium, which brings together groups to share global research and best practices on food security.[29]

Some innovative work on developing climate-resilient agriculture is being done in the region. In a bid to lessen dependence on other countries for food, and develop heat- and drought-resistant, and salt-tolerant crops, some wealthy Arab countries are investing in organizations like the Dubai-based International Centre for Biosaline Agriculture (ICBA). Ismahane Elouafi, the director-general of the organization, and her team of horticulturalists are nurturing breeds of grass, date palms and vegetables that could feed heat-affected populations in the Middle East and other countries, as well as withstand high temperatures on open-air soccer fields when the country hosts the 2022 World Cup.[30] In Jordan's Wadi Araba desert,

a team of engineers is working on a solution for countries on the front lines of climate change, facing drought and rising temperatures. Jordan is currently ranked by the United Nations as the second-water-poorest country on the planet, behind only Bahrain, while increasing desertification due to overgrazing and wasteful irrigation techniques has reduced its grazable lands by 70% in the past three decades. In light of all that, the Sahara Forest Project was conceived as a way to roll back the rapid desertification while addressing food and energy shortages. Engineers have designed a farm that uses solar power to desalinate seawater to grow crops in regions that have been arid for centuries, then uses the irrigation runoff to afforest barren lands and fend off desertification. "The food-energy-water nexus is very connected to climate change, and in order to address them, we believe you need to take an integrated approach to address all three," Joakim Hauge, Sahara Forest Project chief executive officer told the *Christian Science Monitor*. The project has been supported by USAID, the European Union, and the Norwegian government.[31]

In an interview with *NBC News*, Charles Iceland, the Director of Global and National Water Initiatives with the World Resources Institute, summed up the ramifications of water and food insecurity in the region this way: "If there is not enough water for people to drink or cultivate crops in the Middle East, and that's a big concern, those people may need to leave the areas where they live and that could lead to destabilizing migration. It could also lead to an escalation of violent protests".[32]

RISING SEAS AND FLOODING

Paradoxically, in a region dominated by soaring temperatures, drought, and dust storms, rising seas are also impacting the Middle East in low-lying regions like Kuwait, Qatar, Bahrain, the United Arab Emirates and Egypt. In fact, the World Bank declared in 2016 that the MENA region is among the most vulnerable places on earth to rising sea levels.[33] Much of the population resides on the coast. In the affluent Gulf States, significant communities reside on reclaimed land or even on artificial islands. Port infrastructure and the coastal cities that support it are critical to the commerce that flows in and out of the region. Millions risk displacement as city aquifers salinize.[34] Increased extreme weather events in the Gulf to include the impacts of cyclones originating in the warming Indian Ocean threaten storm surges in unprepared coastal centers such as Dubai.[35]

The inundation of the Nile River delta and its urban centers such as Alexandria has already begun.[36] As sea levels rise, the city of five million people is sinking. High waters are flooding basements of buildings leading to fatal collapses. Three people died in January 2019 when a block of apartments collapsed one street back from the seafront.[37] Construction of the Aswan High Dam and the extraction of water upstream has reduced the Nile's flow, decreasing the amount of silt the river deposits. Without silt to replenish delta soils, the whole area is vanishing.[38] This combination of factors, including sea level rise, the over-extraction of water from aquifers, and the sharing of Nile waters with neighboring states, threaten the agricultural productivity of the region.[39] The Nile Delta and Mediterranean coast is responsible for at least 30-40% of the country's total agricultural production, which could be devastated by increases in salt water intrusion. Furthermore, 30% of Egypt's labor force works in the agriculture sector, mostly in the Nile Delta. On fisheries, according to the UN Environment Program, a third of Egypt's fish catches are made in the Delta lagoons which would be negatively impacted by salination.[40]

GLOBAL TRANSITION OUT OF FOSSIL FUELS WILL IMPACT MID EAST ECONOMIES

Given how reliant many of the economies in the regions are on fossil fuel revenues, it is worth briefly discussing how the region will fare as the world transitions away from fossil fuels in an effort to prevent further climate change. The region's centrality to provisioning the energy resources that fuel the global economy have made it an enduring center of security competition. Its strategic importance often makes it both the source of chronic conflict as well as giving it outsized global economic influence. As the global transition away from fossil fuels gains momentum, the economic and political impacts on the Middle East could be significant. To the extent that the risk of confrontation over contested hydrocarbon reserves diminishes as fossil fuels decline in importance for the world economy, the global energy transformation could generate a "peace dividend."[41] On the other hand, instability may arise from Middle East nations dependent on fossil fuel revenues who are largely unprepared for the economic diversification necessary to withstand global decreases in demand for their primary export.

SUB-REGIONAL DISTINCTIONS

SYRIAN CRISIS: CIVIL UNREST AND ARMED VIOLENCE SPIKES

For an early example of climate change implications for conflict, look no further than Syria. Climate change made the 2007-2010 drought preceding the ongoing civil war - identified as the country's worst drought in the historical record - 2-3 times more likely.[42] That drought, coupled with natural resource mismanagement by the Assad regime, displaced millions of farmers and herders, a number of whom migrated to urban centers like Damascus and Aleppo, thus likely heightening the possibility of political unrest.[43] While climate change certainly did not compel Bashar Al-Assad to brutally crack down on his own people, its effect on drought conditions significantly exacerbated the vulnerability of its agricultural and pastoral populations, which may have broadened the appeal of opposition to the regime. As climate change is expected to result in significant precipitation decline in the Middle East and North Africa, significant temperature increases may make entire areas uninhabitable, and water and food shortages will likely increase the likelihood and longevity of instability and conflict.[44]

Syrian refugee camp on theTurkish border for displaced people of the Syrian civil war. September 2012.
Voice of America / Henry Ridgwell

EGYPT: CONVERGING NUCLEAR, CLIMATE AND SECURITY RISKS

Egypt is confronting a multitude of climate change-related and traditional challenges, including terrorism, regional political instability, sea level rise, higher temperatures, and demographic changes. [45]At the same time, Cairo is continuing its long-held ambitions to develop a nuclear energy sector, with construction of its El Dabaa nuclear power plant scheduled to commence in 2020 with help from Russia - a site near Alexandria that is facing significant exposure to sea level rise.[46] According to Andrea Rezzonico and Christine Parthemore of the Council on Strategic Risks:

> *"All nuclear sites and projects around the world must have strong plans in place to ensure safety and security of nuclear materials and technology for decades into the future. We know that in countries such as Egypt, the effects of climate change and various security trends converging will shape that task."* [47]

Many are considering nuclear power as a viable mitigation option to reduce national emissions. The design and operation of these facilities must factor in changing climate stressors such as higher temperatures, extreme weather and sea level rise events to ensure safe, secure operations. Nuclear, climate and security risks are converging as the trend of civil nuclear development in the developing world continues.

IRAQ: WATER INSECURITY IN THE FERTILE CRESCENT

Iraq, like its neighbors, increasingly struggles to supply sufficient water to its people. The drastic deterioration of water supplies during the heatwave in summer 2018 played a central role in triggering anti-government protests and uprisings in southern Iraq. Specifically, at least a dozen people were killed in protests that broke out in the southern province of Basra when over 100,000 people had to go to the hospital due to illness from unclean water supplies (likely from increased salinization).[48] Rainfall has decreased in the south and

A man stands in a dry field in the Mishkhab region, 25 kilometres from Najaf, Iraq. July 2018. AFP

western parts of the country in the past seven decades. According to the UN, Iraq's rivers have decreased to less than a third of their normal capacity. Specifically, the Tigris and the Euphrates are expected to decrease their discharge by a shocking 50% by 2030, compared to 1980s levels.[49] Some experts put the numbers higher than that.[50] The two rivers account for 98% of the Iraqi water supply used for drinking, sanitation and irrigation. Additionally, the quality of the remaining water is deteriorating due to increased salinization. As the Mesopotamia Basin receives between 150-300 millimeters of rainfall annually but experiences 1,500-2,500 millimeters of evaporation per year, it is estimated that 92% of Iraq's total surface area is subject to desertification, while 100 square kilometers of fertile land are lost each year because of salinization[51] and desertification is on the rise.[52] Ever more powerful sand and dust storms are already a major public health consequence of climate-induced desertification,[53] and Iraq is projected to face as many as 300 "dust events" per year in the next decade.[54] All of this has taken a toll on agriculture, which supports one-third of the country's 32 million people living in rural communities.

In many provinces, according to the International Organization for Migration, drought and pollution are the main reasons behind displacement. "This year I could not plant at all," Ali Sagban, a rice farmer in the southern province of Najaf whose farm has faced water shortages for the last five years told *NBC News.* "We used to live unsafe lives because of explosions, now we are living without water."[55]

The link between security and water is not just rhetorical. People in Iraq have seen water weaponized and food and water shortages exploited by the Islamic State (ISIS) over the past decade. It is well documented that ISIS capitalized on weather disasters in rural communities to recruit desperate farmers to their cause. In over 100 interviews with *National Geographic*, Iraqi residents recount how in the aftermath of natural disasters like windstorms, or failed rains, or a drought, jihadists would come to the market where farmers were trying to sell their goods and recruit particularly desperate farmers with cash, food, and promises that their families would be taken care of.[56] Research has also shown that the degree of success ISIS has had in recruiting is correlated to access to water. Around Tikrit, for instance, ISIS attracted more support from water-deprived communities than from their better-resourced peers. In Tharthar subdistrict, farmers with fields on the edge of desertification joined the jihadists in greater numbers than farmers near the river valley.[57]

ISIS used access to water as a strategic and tactical weapon to intimidate local populations and to recruit. Strategic control of fresh water infrastructure was a critical component of its military objectives. When ISIS controlled large swathes of territory across Iraq and Syria, it wrested control of dams that provided drinking water, electricity, and irrigation to millions along the Tigris and Euphrates rivers. Ensuing clashes with Kurdish and Iraqi forces left Shiite holy cities like Karbala and Najaf without water.[58] ISIS also deliberately contaminated water with crude oil and used water to flood 10,000 houses and 200 square kilometers of fertile farmland, wiping out the entire harvest, killing livestock and displacing 60,000 locals.[59] Today, ISIS cells are starting hundreds of fires across the country, destroying vast areas of agricultural fields.[60]

Although ISIS has largely been defeated, the environmental conditions that it took advantage of have not been remedied by the Iraqi government or international partners; if anything, they have gotten worse, and are expected to continue to deteriorate as climate change advances. More than 23 million people live in the Tigris and Euphrates river basin, and experts predict that, because of climate change, the rivers will "disappear this century," making conflict over what remains even more tempting.[61] At such a time, we should recall the lessons from the past decade. In covering the story of how ISIS recruited farmers in the wake of crop failures, the *National Geographic* reporters recount that farmers and agricultural officials they

interviewed often wondered aloud if ISIS would have taken hold the way it did if farmers had only received a bit more help from the Iraqi government. In 2019, Rashid Abbas, a corn farmer in the province of Babylon, south of Baghdad, was among many farmers who led peaceful demonstrations after prolonged drought and the withdrawal of government water for irrigation made planting staple crops impossible. In an interview with *NBC News*, he said the government is, "paying no attention to what we are suffering from. There was a rumor that the protests are the first step of an uprising."[62] A quote from Saleh Mohammed Al-Jabouri, a tribal sheikh from Shirqat, in Northern Iraq, to *National Geographic,* "ISIS is gone for now, but with all these water and heat problems, things will only get worse. We need help now."[63]

YEMEN: CLIMATE, WATER STRESS AND CONFLICT

As the Yemeni government, Saudi Arabia, and the United Arab Emirates compete with Iranian-backed Houthi rebels for influence over the Middle East's poorest country, environmental issues have become a secondary concern. Concurrent cholera outbreaks and financial crises have further compounded Yemen's difficulties, forcing Yemeni officials to dedicate their limited resources to the most immediate problems.[64] Yet, there is an argument to be made that climate change, and in particular the water stress that it has aggravated, played a role in triggering the conflict. Further, there is a wealth of evidence that climate change and its resulting water and food stress are deepening the suffering.

Yemen is among the most water-stressed countries in the world, brought on by regional drought, a naturally dry climate, and failed attempts at management.[65] Before Yemen's civil war started in 2015, the country was already dealing with long-term declines in rainfall, a growing population, increasing cultivation of water-intensive crops, and mismanagement of water resources. Together, these factors had been (and continue) causing water tables beneath Yemen's capital to shrink by roughly three to six meters per year.[66] [67] National water authorities and international development organizations warned that unless urgent steps were taken, water resources could disappear by 2023[68] or 2025[69]. Then, a jump in fuel prices, which are closely linked to the price of water in Yemen, helped spark protests in 2014.[70]

Water scarcity has made the humanitarian situation in Yemen, especially its cities, much worse since the beginning of the conflict. Extreme drought in the midst of Yemen's conflict has led to fierce competition amongst factions for control of water resources.[71] Today, there are urgent calls for humanitarian action as 800,000 people are infected with cholera and the population is gripped by impending famine caused by drought and conflict on top of aid blockades and energy cuts that allow people to pump water for only a few hours a day.[72] In fragile states like Yemen and South Sudan, competition for scarce natural resources is increasing while a growing need for humanitarian assistance undermines states' ability to deal with climate risks, Johan Schaar of the Stockholm International Peace Research Institute told *Reuters.* "I don't see big, shooting wars but I think you will have an increasing frequency of very localized conflicts and tensions that could then escalate into much more."[73]

The war in Yemen has only worsened water scarcity, and climate change will ensure that droughts and other environmental issues only grow in the years to come. Along with shortages of fuel, which makes water production and transport of goods expensive, the shortage of water is hurting the agricultural sector, a critical part of the Yemeni economy. With reduced rains come reduced harvests, which means that little food can be stored for times of conflict.[74] Dr. Moosa Elayah, a Yemeni researcher with

the Center for International Development Issues in Nijmegen, the Netherlands told *Red Cross Red Crescent Magazine*, "We are facing starvation level in many parts of the country and I think it will get even worse with climate change."[75] Abdulhakim Aulaiah, a former official in Yemen's Environmental Protection Authority similarly told *The New Arab*:

> *"Climate change has affected most aspects of life in Yemen. Sea level rise is causing environmental issues in ports such as Aden and al-Hodeidah. As a result of unusually high temperatures, malaria is spreading. Fluctuations in rainfall have affected crop yield across Yemen. The supply of fish in the seas around Yemen is decreasing, and several species have vanished. Climate change is one of the biggest threats to biodiversity."*[76]

REGIONAL SECURITY INSTITUTIONS: RISKS AND RESPONSES

The Middle East also remains at the center of some of the globe's most intractable security dilemmas. The region has a legacy of conflict manifesting in civil war, proxy war, great and regional power intervention in Iraq, Yemen, Lebanon, Syria and beyond. Although the region does lack an organic regional security structure, it has been the focus of external regional and international security mechanisms for decades.

NATO has the capability and capacity to conduct missions intended to mitigate climate driven instability in the Middle East pending the political consensus to do so. NATO allies in the region have already experienced degradation to force readiness due to water scarcity and extreme heat impacts on base infrastructure and operations.[77] Naval bases and other security infrastructure in places such as Bahrain and Qatar as well as the heavily militarized Strait of Hormuz are critical to regional as well as NATO security forces.

In recent years, the UN Department of Peacekeeping Operations (DPKO) has tasked two UN peacekeeping missions, UNAMI[78] in Iraq and MINUSMA[79] in Mali to take into account how climate change aggravates resource stresses and by extension tensions between conflicting groups. This is the first time UN Headquarters has directed mission commanders in the field to assess climate and security impacts. Equally significant, receipt of the Commander's mandatory, recurring reports will require greater consideration of climate and security in the UN Security Council.

Addressing resource instability in the Middle East is a high priority for the European Union due to the region's close proximity. The EU still hopes to realize Common Security and Defence policy missions that inter alia would address migration flows and imported insecurity.

Although the region lacks formal cooperative security institutions - outside annual military exercises such as operation Eager Lion[80] - tremendous security resources, both material and financial, have been invested by the United States, Russia, China, and other external powers, as well as the region's wealthier states, all seeking strategic advantage. Greater foresight is required from both great powers and the governments of the region they support to transition a sufficient amount of traditional investment and military aid into climate adaptation focused resources necessary to cope with emerging climate driven instability. Committing to preparation will be essential to forestalling the slide of already fragile societies into the failed states.

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NORTH AMERICA

THE BROAD REGIONAL PICTURE OF CLIMATE SECURITY RISKS

Like other regions of the world, taken collectively, the three countries of North America are facing a full range of climate impacts and ensuing security challenges from those impacts. In a relative sense, North America is less exposed to the more extreme geographic climate risks that confront regions in the Global South. However, this advantage has been strained in recent years with increasingly severe storm surges driven by sea level rise, as well as more intense storms and wildfires. To the extent that these countries have policies in place to address and prepare for the national security implications of climate change, Mexico, Canada, and the United States are doing so individually, or in concert with the international community and international security organizations. Therefore, this section begins with an overview of climate security risks in each individual country, followed by how climate change is impacting regional and national security institutions, and how each nation's military or other security institutions are responding to the threats.

SUB-REGIONAL DISTINCTIONS

MEXICO: WATER, FOOD AND SEA LEVEL RISE

Mexico is particularly vulnerable to the impacts of global climate change, specifically from sea-level rise affecting coastal areas and inland basins. Increased sea surface temperatures in the Gulf of Mexico are causing intensified hurricanes, and changes in the hydrological cycle which in turn are leading to increasingly heavy rains, strong storms, as well as longer and more frequent droughts.[1] One of the climatic phenomena that affects temperature associated with severe droughts in the north and central part of the country is El Niño. It is estimated that the climate change effects on El Niño will continue to increase, exposing Mexico to more extreme weather events and natural, economic and human disasters.[2]

More intense droughts, rain, and tropical cyclones will in turn exacerbate inequities in employment, health, and access to food, water and other resources. All of these factors could affect security conditions in the country.[3] Economic impacts include a potential scarcity of goods and services, as well as adverse impacts on energy and transportation infrastructure. In the near future, it is anticipated that climate change could exacerbate social, economic and political problems in Mexico. Facing these scenarios, Mexico is working to mainstream climate change and natural disaster mitigation in its planning processes.[4] As Arnoldo Kramer, Mexico City's chief resilience officer, told *The New York Times*, "Climate change has become the biggest long-term threat to this city's future. And that's because it is linked to water, health, air pollution, traffic disruption from floods, housing vulnerability to landslides — which means we can't begin to address any of the city's real problems without facing the climate issue."[5]

Las Colonias Dam, El Charco del Ingenio botanical garden, San Miguel de Allende Guanajuato, Mexico. December 2013.
Gerardo Noriega / WikiMedia

WATER AND FOOD SECURITY

In Mexico, water supplies are already strained because of factors like population growth, and inadequate infrastructure. Climate change makes that situation worse.

The situation in Mexico City is especially fraught. Centuries ago, the city was known as "the Venice of the New World" because of its enormous lakes. But today, Mexico City must get its water from far away or pump it from deep underground.[6] In 2017, *The New York Times* conducted an in-depth story on the dire water problems there. Perennially short on water, the city keeps drilling deeper for more, weakening ancient clay lake beds on which the Aztecs built much of the city, causing the land to subside. Climate change makes the situation worse. As temperatures rise and droughts become more intense, more water evaporates and the demand for water increases, adding pressure to tap reservoirs or drain underground aquifers, accelerating the city's collapse. The subsidence problem is not merely theoretical. In one neighborhood, where nearly two million people live, many unable to count on water from their taps, 15 schools have crumbled and a teenager was swallowed up when a crack in the brittle ground split open a street.[7]

Mexico City today is home to 21 million people. Millions of migrants have poured into the city from the countryside to find jobs. The city's development, from 30 square miles in 1950 to about 3,000 square miles today, has wiped out nearly every remaining trace of the original lakes on which the Aztecs first built the city, taxing the underground aquifers and forcing what was once a water-rich valley to import billions of gallons from far away.[8] Mexico City now imports as much as 40% of its water from remote sources. More than 40% of what runs through its 8,000 miles of pipes is lost because of leaks and pilfering. Also, pumping all this water uphill into the mountains consumes roughly as much energy as does a city the size of Philadelphia.[9] Even with this herculean effort, at least 20% of Mexico City residents can't count on getting water from their taps each day. For some residents, water comes only once a week, or once every several weeks, and the quality of the water that does come is suspect. People living in poor neighborhoods who have to hire trucks to deliver drinking water, often pay exponentially more for water than wealthy residents pay in better-served neighborhoods.[10] Climate change, while not the only factor, is predicted to only make this precarious water situation worse, and the impact will fall heaviest on poor communities.[11]

Water insecurity also means food insecurity. In 2011, Mexico had its worst drought on record. More than 1.7 million cattle died of starvation or thirst, and at least 2.2 million acres of crops withered across at least five states. The government was forced to haul water to 1,500 villages and send food to farmers who lost all their crops. Climate change is related to drought because as humans release more and more greenhouse gas emissions into the air, they trap more and more heat, meaning the air temperatures rise. As air temperatures rise, more moisture evaporates from land and lakes, rivers, and other bodies of water. Warmer temperatures also increase evaporation in soil, which affects plant life and can reduce rainfall even more.[12] The result of this process in Mexico, like in many other places around the world, is that climate change is making Mexico's land far less suitable for growing food. Some estimates predict that climate change could lead to a 40 to 70% decline in Mexico's current cropland suitability by 2030. This could soar to an 80 to 100% decline by the end of this century. That means Mexico could potentially lose over half its workable farms in less than 12 years – and all of them by 2100.[13] If those numbers are accurate, that scenario is not merely a cause for concern, it is a catastrophe in the making.

Loss of cropland can mean malnourished populations, internal displacement, and ultimately permanent migration, especially by rural families. One study predicts that 10% of Mexicans ages 15 to 65 could eventually try to emigrate north as a result of rising temperatures, drought and floods, potentially scattering millions of people and heightening political tensions over immigration.[14] "A lot of [Mexican migration] is being driven either by vulnerability to crop loss, or wage laborers losing their jobs because farmers can no longer afford to hire them," Arizona State University development economist Valerie Mueller told *The New York Times* in 2017.[15]

SEA LEVEL RISE

University of Miami professor and sea level rise expert Harold Wanless has asserted that "most of the barrier islands of the world will become largely uninhabitable (within 50 years)."[16] Due to natural variations in sea level and climate phenomena like El Niño, some regions may see more of a rise sooner than other spots. Mexico's Yucatan Peninsula may be the first place to validate Wanless' projections. It is among the world's most threatened areas when it comes to the potential impacts of rising regional sea levels.[17] The Yucatan Peninsula is vulnerable economically as well as ecologically. The peninsula has a high population density and extremely valuable tourism infrastructure. If climate change scenarios continue to play out, many related changes are anticipated which would be extremely consequential for the Yucatan: from accelerated sea level rise, to more frequent and intense storms, to ocean acidification, an increase in the incidence and spread of diseases, and alteration to the availability of fish stocks.[18]

When record-breaking Hurricane Wilma hit the Yucatan peninsula in 2005, parts of Cancun saw the beach washed away completely. Mexico tried a quick fix of the beaches in 2006, but waves washed away the new sand relatively quickly. In 2009 Mexico launched a $70 million project to restore about 7 miles (11.3 kilometers) of beach, at a cost of $10 million per mile ($6.2 million per kilometer). However, a year later, the ocean had already swept away about 8% of the new sand, even without any major storms. And sea level rise that has already occurred is making average storm waves riding in on high tide more erosive than the waves of 30 years ago.[19]

An analysis of the potential economic impacts of increasing sea level rise along the Gulf Coast of Mexico looked at the negative economic impact on infrastructure in the largest urban centers (Cancun, Isla Mujeres, Playa del Carmen, Puerto Morelos and Cozumel), Mexico's largest resort cities. Tourism in this area brings in more than 8 billion dollars per year to the Mexican economy. A conservative economic assessment of the impact of SLR under a conservative one meter rise scenario for all coastal cities is $330 million USD. Projections for worse scenarios predict that the cost of inaction could reach between $1.4 billion to $2.3 billion.[20]

Three Mexican states have jurisdiction over this territory – Yucatan, Quintana Roo and Campeche. Under the Mexican General Climate Change Law, each state must set out a plan for climate action with specific mitigation and adaptation actions. The states began coordinating their climate response as early as 2010, and each has prepared a Regional Climate Change Act (called a PEACC) and agreed to collaborate on adaptation strategies. In 2016 the three states signed the Sustainability Agreement for the Yucatan Peninsula, which has specific activities and goals for climate change mitigation and adaptation.[21]

CANADA

Both past and future anticipated warming in Canada is, on average, about double the magnitude of average warming worldwide. The situation in Northern Canada and the Arctic are even more extreme, with heating up to three times faster than the global rate, according to a recent report.[22] Receding ice in the Arctic is expanding interest in northern shipping and resource exploitation — and raising questions about which countries have ownership over the vast Arctic region. Oceans surrounding Canada have warmed, become more acidic, and less oxygenated, consistent with observed global ocean changes over the past century. These changes threaten the health of marine ecosystems.

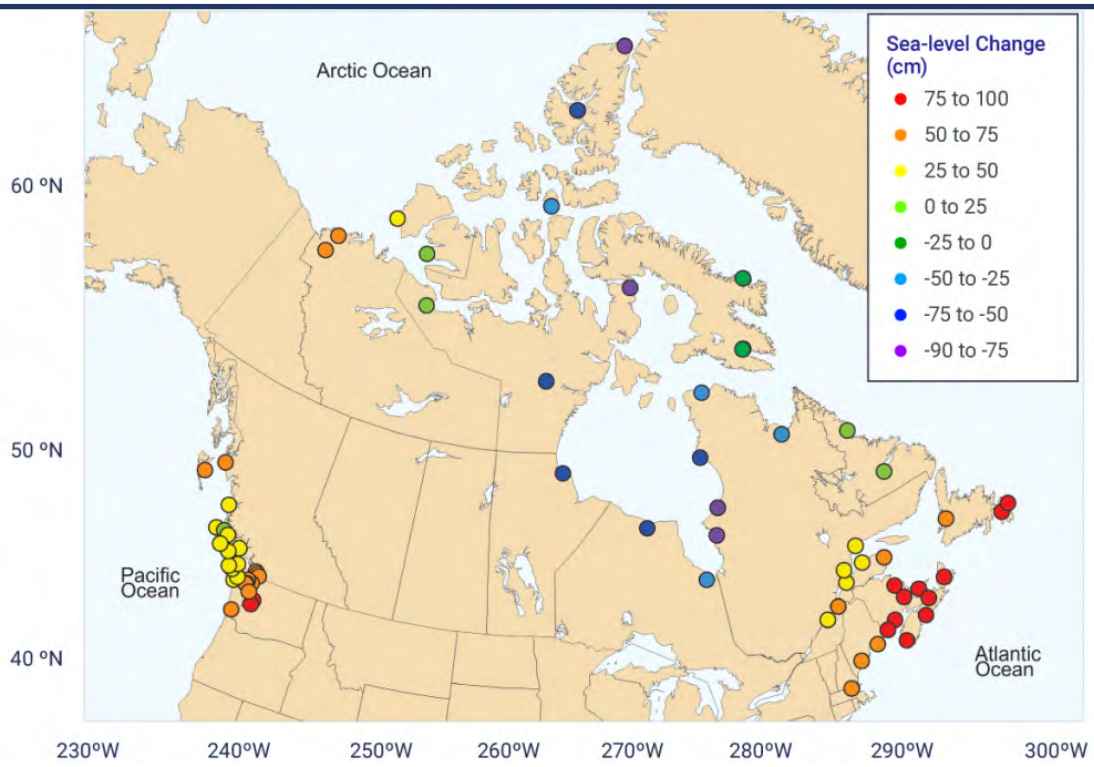
The effects of widespread warming are already evident in many parts of Canada and are projected to intensify in the future. In Canada, these effects include more extreme heat, less extreme cold, longer

PEI is highly vulnerability to storm surges and rising sea levels associated with climate change.
Don Jardine / Regional Adaptation Collaborativ

growing seasons, shorter snow and ice cover seasons, earlier spring peak streamflow, thinning glaciers, thawing permafrost, and rising sea level. Because some further warming is unavoidable, these trends will continue.[23] A warmer climate will intensify some weather extremes. Extreme hot temperatures will become more frequent and more intense. This will increase the severity of heatwaves, and contribute to increased drought and wildfire risks. More intense rainfalls will increase urban flood risks. Warmer temperatures and smaller snowpacks may also combine to affect the frequency and magnitude of snowmelt-related flooding.[24]

Canadian areas of the Arctic and Atlantic Oceans are already experiencing longer and more widespread sea-ice-free conditions. Canadian Arctic marine areas, including the Beaufort Sea and Baffin Bay, are projected to have extensive ice-free periods during summer by mid-century. The last area in the entire Arctic with summer sea ice is projected to be north of the Canadian Arctic Archipelago. This area will be an important refuge for ice-dependent species. Coastal flooding is expected to increase in many areas of Canada due to local sea level rise.[25] Local sea level is projected to rise, and increase flooding, along most of the Atlantic and Pacific coasts of Canada and the Beaufort coast in the Arctic where the land is subsiding or slowly uplifting. The loss of sea ice in Arctic and Atlantic Canada further increases the risk of damage to coastal infrastructure and ecosystems as a result of larger storm surges and waves.

Nova Scotia, Prince Edward Island and parts of New Brunswick and the island of Newfoundland, will experience sea level rise higher than the global average during the coming century.[26] According to data available via sealevelrise.ca, a joint initiative of conservation groups and federal and provincial governments and universities, 60% of the population of New Brunswick, 70% of the population of Nova Scotia and 90%t of the population of Newfoundland and Labrador live in coastal communities, and no place in Prince Edward Island is further than 16 kilometers from the coast.[27]



An illustration included in Canada's Changing Climate Report, which shows projected relative sea level changes in the year 2100 for a high emission scenario at 69 coastal locations in Canada and the northern United States.[28]

Halifax, home to Canada's largest naval base, could see a 20-centimeter increase in mean sea level rise and a quadrupling in flooding in the next two or three decades even in a low-emissions scenario. In a high emission scenario, the impact could be doubled, according to Thomas James, a research scientist with the Geological Survey of Canada.[29] Large impactful events, such as high-water levels reached once every 50 years at Halifax in the past, may occur as frequently as every two years by mid-century under the relative sea level rise caused by a high emission scenario. To make matters worse, James said that in some more northern areas, like in the Gulf of Saint Lawrence and along the Labrador coast, sea ice duration is expected to decrease causing less shoreline protection for things like storm surges.[30]

In Western Canada, changing rain patterns will make droughts more frequent and more intense across the southern Prairie region in summers. That could have a significant impact on the agricultural industries based there, despite the fact that the growing season itself will likely get longer as a result of fewer days with frost. Kai Chan, a professor with the Institute for Resources, Environment and Sustainability at the University of British Columbia, in an interview with the West Block said, "...as precipitation patterns change, we're going to see less precipitation in some of those important growing areas, much longer droughts, more risk of forest fires, greater risk of floods."[31] In fact, the 2019 wildfire season burned about 817,256 hectares — the largest area burned in Canada in 38 years.[32]

UNITED STATES

As a geographically and climatically diverse nation, the United States is exposed to vast and varied impacts from climate change. For instance, like Canada, the U.S. is an Arctic nation, with all that portends, both ecologically and geopolitically. The impacts of climate change on the Arctic and its security implications are further discussed in the section on the Poles. The United States also has many islands from the Gulf of Mexico to the South Pacific, many of which are extremely vulnerable to climate change. The U.S. interior is prone to heat waves, droughts, and severe flooding; the East and Gulf coasts are increasingly being battered by hurricanes, which combined with rising sea levels have led to devastating storm surges in coastal cities and towns. In brief, the United States faces the whole gamut of climate impacts from melting permafrost to wildfires, and sea level rise to drought.

IMPACTS ARE ALREADY BEING FELT

On the ground, climate change is battering the U.S. today. In 2019, scientists from the National Center for Atmospheric Research modeled sea level rise for 20 cities worldwide. They found that cities like Boston and New York might experience twice the global mean increase.[33] While sea level is rising globally at about a tenth of an inch per year, cities along the U.S. eastern seaboard, such as Norfolk, Baltimore, Charleston, and Miami, among others, have suffered "sunny day" flooding from seas rising far faster than the global average. A 2018 study showed that from 2011 to 2015, sea level rose up to 5 inches — an inch per year — in some areas from North Carolina to Florida. Researchers attribute this faster rise to a slowing Gulf Stream, shifts in a major North Atlantic weather pattern, and the effects of El Niño climate cycles.[34] "These coastal areas are more vulnerable than they realize to short-term rapid acceleration of sea level rise," Andrea Dutton, a University of Florida geologist who studies the history

North Carolina after Hurricane Florence. September 2018. VOA / WikiMedia

of sea level fluctuations told a publication of the Yale School of Forestry and Environmental Studies. "If they're hanging their hat on sea level rise projections looking at the potential over decades, they need to refocus and think about the potential for short-term variability in that rate."[35]

Sunny day flooding has increasingly disrupted coastal cities in the southeastern U.S. coast. In Charleston, tidal flooding increased to 50 days in 2016, up from four days annually 50 years ago, causing millions of dollars in damage and disrupting travel to the city's hospital district. In Miami, flooding during unusually high tides is becoming an increasingly severe problem, with clear-weather flooding accelerating to nearly 20 days a year. But much worse is to come. A report earlier this year from the National Oceanic and Atmospheric Administration (NOAA) said that "by 2100, high tide flooding will occur every other day (182 days/year) or more often" under an "intermediate low" scenario along the Atlantic coast and the western Gulf of Mexico. Scientists have been steadily increasing their estimates of how much sea level overall will rise this century from melting glaciers and polar ice sheets. The current best estimates are in the range of 3 to 6 feet.[36]

Wildfires are also an increasing problem throughout the American west from Texas to California to Alaska. Alaska had a near-historic wildfire season in 2019 with more than 2.5 million acres burned. July 2019 was the warmest month ever recorded in Alaska,[37] and for the first time ever, Anchorage was classified as being in a "severe" drought, according to the National Integrated Drought Information System.[38] Late-season wildfires, primed by the record-breaking heat and dry conditions, destroyed homes, forced evacuations, closed roads and schools, and poured sometimes-dangerous levels of smoke into the state's most populous region. Several fires started or rekindled during a time of year when blazes are usually winding down and when late-summer rains normally drench the landscape. Tim Mowry, a spokesman for the Alaska Division of Forestry told *Reuters*, "It's not raining, unfortunately."[39]

The year 2019 was an especially damaging wildfire season in California as well. The fires were so bad that power had to be cut off to millions of homes and businesses several times during days with forecasted high winds and extremely dry conditions. This step was designed to minimize wildfires, but it also caused billions of dollars in losses.[40] Unfortunately, the 2019 wildfire season in California was part of a trend. The past decade has seen half of the state's 10 largest wildfires and seven of its 10 most destructive fires. A 2019 study found that since 1972, California's annual burned area has increased

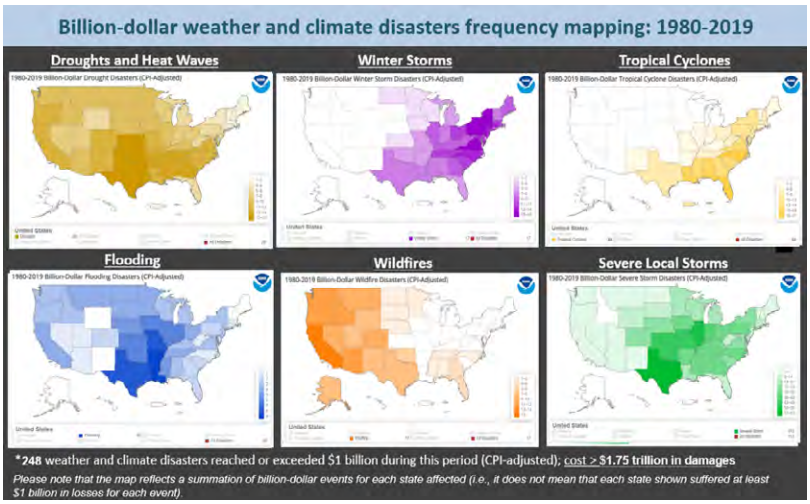
more than fivefold, a trend the study said was clearly attributable to the changing climate. [41]This is because climate change has already redefined the seasons in Northern California. Since the early 1970s, summers in Northern California have warmed by about 2.5 degrees Fahrenheit. "Each degree of warming causes way more fire than the previous degree of warming did. And that's a really big deal," Park Williams, a climate scientist at Columbia University and an author of the study, told *The Atlantic*. Every additional increment in heat in the environment speeds up evaporation, dries out soil, trees and vegetation, turning them into ready fuel for a blaze.[42]

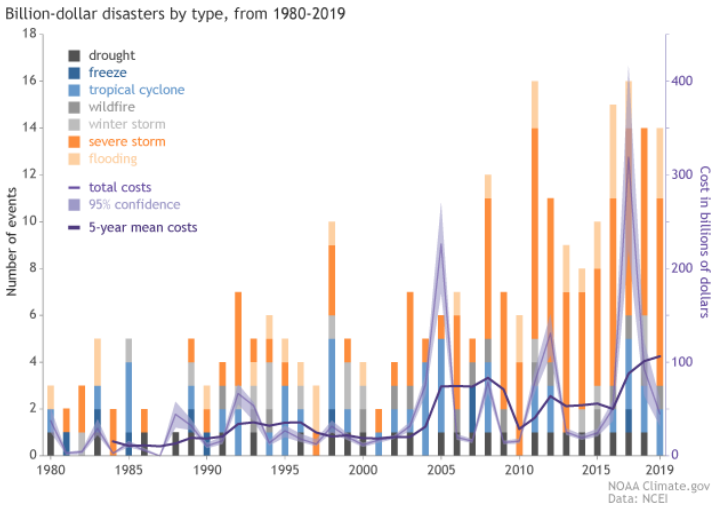
As climate change destabilizes weather and atmospheric patterns, storms and other extreme weather events are becoming more frequent and more intense. NOAA's National Centers for Environmental Information (NCEI) tracks U.S. weather and climate events where the overall damage costs reached or exceeded $1 billion (adjusted for inflation). NCEI's analysis shows that the number and cost of disasters are increasing due to a combination of increased exposure (i.e., property values at risk of possible loss), vulnerability (i.e., intensity of wind speed, flooding, etc., and how much corresponding damage that causes) and the fact that climate change is increasing the frequency of some types of extreme weather events.[43]

Each state has been affected by at least 1 billion-dollar disaster since 1980. Texas has experienced the highest number of events (111) and also leads the U.S. in total cumulative costs (~$250 billion) from billion-dollar disasters since 1980. Florida is the second-leading state in total costs since 1980 (~$225 billion). Increases in population and material wealth are one cause of the rising costs. A lot of development has also taken place in vulnerable areas like coasts and river floodplains. Climate change is increasing the frequency of some types of extreme weather that leads to billion-dollar disasters—most notably, more intense droughts, longer wildfire seasons in the western states, and extremely heavy rainfall in the eastern states. In 2019, the U.S. suffered 14 separate billion-dollar disasters -- the fourth highest total number of events (tied with 2018), following the years 2017 (16), 2011 (16) and 2016 (15). Over the last five years, the U.S. has experienced 69 separate billion-dollar disaster events, or an average of 13.8 events per year, well above the inflation-adjusted average of 6.5 events per year from 1980-2019. The total cost of losses over the past 15 years from only these large-scale, billion-dollar events are $1.16 trillion in damage.[44]

REGIONAL AND NATIONAL SECURITY INSTITUTIONS: RISKS AND RESPONSES

The North Atlantic Treaty Organization (NATO) and the North American Aerospace Defense Command (NORAD) are the two regional security organizations of note in North America. Canada and the United States are members of both, and Mexico is a member of neither. NATO's actions on climate change are discussed in the section on Europe. Within NORAD, as it relates to climate change, the U.S. and Canada train and plan for environmental changes in the Arctic region, extreme weather events, disasters, and search and rescue (SAR) missions.[45] The Arctic is addressed in the section on the Poles. The Inter-American Defense Board (IADB), a component entity of the Organization of American States, does include Canada, Mexico and the United States, and has in recent years addressed the security implications of climate change. For example, on June 25, 2019, the IADB held a conference titled "Climate Change and its Impact on Security and Defense," though it was initiated and led by the Chilean military.[46] However, most actions on climate and security in North America have been by national security institutions in the respective countries.





MEXICO

In Mexico, coordination on addressing climate change, and planning among the various levels of government and agencies, is managed through a National Climate Change System (NCCS) which was set out in Mexico's General Climate Change Law. At the federal level, two important bodies were created to design and implement climate policy: the Interministerial Commission on Climate Change (CICC), and the National Institute for Ecology and Climate Change (INECC). To coordinate action at the subnational level, the Federal Congress is part of the NCCS, as well as the States and national associations of municipal officials. Finally, the Climate Change Council (C3) was created to advise the government. The CICC is a body of 13 Federal Ministries: the Ministry of Environment and Natural Resources, Ministry of Foreign Affairs, Ministry of Energy, Ministry of Finance and Public Credit, Ministry of Social Development, Ministry of the Interior, Ministry of the Navy, Ministry of Economy, Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food, Ministry of Communications and Transportation, Ministry of Public Education, Ministry of Health, and Ministry of Tourism.[47]

The Inter-ministerial Commission on Climate Change has institutionalized planning for climate change and its associated natural disasters and risk management processes. Mexico has also developed a National Strategy on Climate Change and a Special Program that identifies adaptation policies and measures aimed at risk mitigation for disasters.[48] The INECC coordinates the evaluation of climate change (mitigation and adaptation) through a technical secretariat.[49] As of late 2019, there were 88 institutional initiatives that contribute to the national climate adaptation portfolio. Half of these focus on environmental management and the remainder are managed by members of the CICC working on planning, law, infrastructure, early warning systems, finance and research.[50] For example, the country aims to stop deforestation, as well as to cut in half the number of cities that are particularly vulnerable to the impacts of climate change, and to install early warning systems throughout the country. [51]

Despite these institutional frameworks, Mexican public officials acknowledge that the federal and state governments do not have the resources to deal with the most impactful climate scenarios, like a serious water shortage, which if they occurred could cause serious security implications internally

in Mexico and potentially within the region. Ramón Aguirre Díaz, director of the Water System of Mexico City, is frank about the perils ahead. "Climate change is expected to have two effects," he told *The New York Times*. "We expect heavier, more intense rains, which means more floods, but also more and longer droughts." If it stops raining in the reservoirs where the city gets its water, "we're facing a potential disaster," he said. "There is no way we can provide enough trucks of water to deal with that scenario." "If we have the problems that California and São Paulo have had," he added, "there is the serious possibility of unrest."[52]

CANADA

From a security perspective, Canada is a member of the North Atlantic Treaty Organization (NATO), and NATO has recognized climate change as a threat multiplier and a specific threat to transatlantic security.[53]

The Canadian armed forces have also implemented initiatives to reduce their emissions. At a Climate Change Symposium held by the Centre for National Security Studies in February of 2018, Mr. Saleem Sattar, Director General of Environment and Sustainable Management for the Department of National Defence presented several green initiatives that the Canadian Armed Forces are pursuing under the department's "Strong, Secure, Engaged" policy.[54] Among other things, that policy calls for reducing greenhouse gas emissions by 40% from 2005 levels by 2030 (excluding military fleets), investing $225 million in infrastructure projects to reduce carbon footprint, transitioning 20% of non-military vehicle fleets to hybrid and electric, and examining alternative energy options for operational purposes.

Like the rest of the world, Canada has already experienced the security threats that come with climate change in a number of ways. First, as discussed above, Halifax, home to Canada's largest naval base, is expected to see significant sea level rise and flooding in the years to come. Halifax and other military installations could suffer significant damage to property and equipment. Canadian forces have also been increasingly called on to respond to floods and forest fires around the country, causing Minister of Defence Harjit Sajjan to warn that the number of Canadian Forces personnel available to deal with environmental disasters induced by climate change may have to be raised should their frequency continue to grow. Arctic melting also poses a threat to Canadian sovereignty, as the far north's increased navigability is already seen as an economic opportunity by countries from the U.S. to Russia who view far-north territory like the Northwest Passage as international waters. The threat of climate change has been consistently recognized in "Strong, Secure, Engaged," the Canadaian Defence Policy.

The country's top military commander told the *Canadian Broadcasting Corporation* (CBC) in a recent interview that Canada's Armed Forces are being pushed to the limit responding to an increasing number of climate-related events such as floods and fires.[55] Currently, the Canadian Armed Forces are deployed to Newfoundland for snow removal as the province has been in a state of emergency coping with unprecedented snowfall. In 2016, the Canadian armed forces responded to only one climate disaster, the wildfire in Fort McMurray. But that number jumped to six deployments in each of the following two years. Gen. Jonathan Vance, the chief of the defence staff, says he needs more men and women to handle these crises and his soldiers need more training to deal with fires and floods. Just this spring more soldiers were deployed to assist states of emergencies — during floods in Ontario, Quebec and New Brunswick as well as wildfires in

Alberta — than were deployed overseas. These calls for assistance are stretching the military beyond what it was originally designed to handle, Vance said. "Our force structure right now, I would say, is probably too small to be able to deal with all of the tasks."[56]

The combination of disaster-response operations at home and abroad also has a human impact on Canadian forces. Gen. Vance explained that deploying troops to help with climate-related events can put a significant burden on individual soldiers and take them away from family life. "If you think of the average year in the life of a soldier, they might be away six months doing an operation outside of Canada, come home, during that reconstitution period — the period of time that they're with their family, and sort of getting back into the swing of things back home — they could be called out again in their thousands to be dealing with the effects of climate change," he said.[57]

UNITED STATES

THREATS TO MILITARY BASES INCREASING

As discussed above, in the past decade the United States has seen an ever-increasing number of extreme weather- and climate-related disasters which have each cost billions of dollars. U.S. military bases have not escaped this disturbing trend. In April 2019, each service branch of the U.S. armed forces released "top ten" lists of their military bases most vulnerable to climate change, and despite the numerical limit, the U.S. Navy listed sixteen.[58] In this section we will describe a few of the extreme weather events and climate change-related impacts that have affected military installations in just the last few years.

In September 2018, Hurricane Florence hit Marine Corps Base Camp Lejeune, North Carolina and then stalled out over the area, dumping around 30 inches of water in the ensuing three days. In total, 4.5 million square feet, or 30%, of Camp Lejeune's buildings were damaged,[59] in addition to a Marine Corps-owned rail line that ships heavy equipment on and off base (which was still unusable as of July 2019) and a bridge over the Intracoastal Waterway to the barrier island where the Marines conduct amphibious assault training. The Marines' amphibious training beach itself was partly washed away. The Marine Corps' top officer at the time, General Robert Neller, told the Senate Armed Services Committee in December 2018 that the total repair bill for the base would be $3.6 billion.[60] More than a year after the storm, repairs were still not complete. As Defense Secretary Esper was briefed when he visited the base in September 2019, 90% of the way through repairs, the base ran out of money. When the Marine Corps could no longer pay, contracted labor moved on to work at other military bases which had also suffered disasters, like Tyndall Air Force Base, Florida, Offutt Air Force Base, Nebraska, and Marine Corps Recruit Depot Parris Island, South Carolina, creating a competition amongst disaster zones for skilled labor to make repairs.[61]

Indeed, Hurricane Michael hit Tyndall Air Force Base (AFB) in October of 2018, less than a month after Hurricane Florence devastated Camp Lejeune. About 300 of the Air Force base's nearly 500 damaged buildings are slated to be razed.[62] The base was not able to regain adequate operating status for almost a month, and was still recovering from the damage seven months later, with no signs of a swift return to normal.[63] During the recovery period, critical training and maintenance schedules for almost one-third of the nation's F-22s was disrupted, forcing the fighter jets to relocate to other

Offutt Air Force base flooded on March 17, 2019, caused by increased water levels of surrounding waterways. U.S. Air Force / TSGT. Rachelle Blake.

regional air bases less able to run such a high volume of them.[64] Although the waters off Tyndall have already risen by about 5 inches since 1987, and are projected to rise even more, the Air Force wants at least $4.25 billion to rebuild Tyndall at its current location on the Florida panhandle, a process which could take several years.[65]

Similarly, at Offutt AFB in Nebraska, a prior flood in 2011 had already prompted officials from the base, the City of Omaha, and various other local cities and counties to collaborate on a land use management plan. In 2015, that plan warned that the levee needed to be built up, and cautioned that climate change might make matters worse. It stated, "Due to changes in the base flood elevation of the Missouri River, Federal Emergency Management Agency (FEMA) has identified the need to raise the levee between two inches to several feet for it to be capable of protecting the installation."[66] In particular, FEMA ordered 19 miles of levees along the Missouri to be raised by 2 feet to protect Offutt and portions of Omaha, including one of the city's wastewater treatment facilities. However, the levees were not reinforced in time for the "500 year" flood that hit the base in March 2019. As a result, less than six months after Tyndall AFB was decimated, Offutt AFB was hit by a mix of melting snow and an additional "bomb cyclone" which produced record-setting flood levels. Within hours, 30 buildings, 30 structures, and two aircraft maintenance facilities were under eight feet of water, and 3,000 feet of the base's runway was submerged. The Air Force estimated that it would need $1.2B in FY 2019 and $3.7B in FY 2020 to begin the recovery process on both Tyndall and Offutt.[67]

Apart from storms, sea level rise also poses a clear and present danger to many key U.S. military installations. For example, it is well known that the Hampton Roads area, home to Naval Station Norfolk, the world's largest naval base, is one of the United States' most vulnerable areas to sea level rise and recurrent flooding. According to a January 2019 report from the Office of the Under Secretary of Defense for Acquisition and Sustainment, Joint Base Langley-Eustis (JBLE-Langley AFB), Virginia,

has experienced 14 inches in sea level rise since 1930 due to a combination of localized land subsidence and sea level rise.[68] In 2016, an independent analysis by the Center for Climate and Security found that, "Four installations—Naval Air Station Key West, Joint Base Langley-Eustis, Dam Neck Annex, and Parris Island—are at risk of losing between 75 and 95% of their land."[69] Less well known, Diego Garcia, a small British island in the Indian Ocean (leased to the U.S. by the United Kingdom), is a strategically and operationally vital base. The U.S. military has launched operations in Iraq and in southern Asia from there and uses it to refuel jets. "It is arguably the most strategic island that Americans have never heard of," Rear Admiral David Titley, former Oceanographer of the Navy, told *Roll Call*. "That entire atoll is about 1 or 2 meters above sea level." Another island in the South Pacific, Kwajalein, houses ballistic missile defense equipment. Personnel there watch for U.S.-bound projectiles from North Korea. But the atoll could be uninhabitable by 2035, when it's projected the fresh water supply may run out.[70] Two long-range air-defense radar stations on the north slope of Alaska are similarly under threat from coastal erosion.[71]

Rather than too much water from storms and flooding, some U.S. bases suffer from too little water and a resulting wildfire risk that can impact training. The largest hotspots for water stress are in the West, with the overallocated Colorado River basin in its nineteenth year of drought and the Ogallala aquifer (which underlies parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming) continuing to decline. Recent reports have identified Fort Stewart in Georgia, Vance Air Force Base in Oklahoma, and Mountain Home Air Force Base in Idaho as facing risks from insufficient access to water.[72] In Colorado, in March 2018, two wildfires broke out during an infantry and helicopter training exercise for an upcoming deployment due to live fire training in gusty winds and dry conditions. The fire burned 3,300 acres, destroyed three homes, and caused the evacuation of 250 homes.[73] In the summer of 2018, record-breaking high temperatures (up to 112 degrees) dominated Central Texas. On Fort Hood, what began as a small grass fire within a training area, grew to an 8,500 acre blaze,[74] causing the base to halt live-fire gunnery exercises. "The record heat and extreme dry conditions have created intense fire behavior," Bob Adams, chief of operations for the Fort Hood Directorate of Emergency Services told the base newspaper in an interview. "The fires are burning extremely hot and burn the dry vegetation very quickly." More than 60,000 man-hours were dedicated to tackling the blazes.[75]

Apart from fires, temperature increases themselves can have a detrimental effect on training, increasing the incidence of heat injuries and illness in military personnel. This is especially true of intensive training and operations conducted with restrictive clothing and heavy gear. As the temperature reaches progressively higher heat categories, or "flag" levels, additional restrictions to training are enforced, and conducting the same evolution requires additional planning, and logistical support such as having coolers filled with ice water-soaked bed sheets or having trained medical personnel on hand. Despite these precautions, a rising number of military members are falling ill because of the heat. In 2008, 1,766 cases of heatstroke or heat exhaustion were diagnosed among active-duty service members. By 2018, that figure had climbed to 2,792, an increase of almost 60% over the decade. According to a recent investigation, the health effects of heat on U.S. military personnel have cost $1 billion in "lost work, retraining and medical care" between 2008 to 2018.[76] All branches of the military saw an increase in heat-related illnesses, but the problem was most pronounced in the Marine Corps, which saw the rate of heatstroke more than double from 2008 to 2018.[77] Unfortunately, temperatures are only expected to rise. A 2016 study predicts that by the end of the century the southeastern U.S. will

experience 75 more "black flag" days per year. Already, slightly more than 40% of the U.S. military's heat-related illnesses and deaths over the last five years occurred at five military installations in the Southeast: Fort Benning in Georgia, Fort Bragg in North Carolina, Fort Campbell in Kentucky, Fort Polk in Louisiana and Camp Lejeune, in North Carolina, according to the Defense Health Agency.[78] The 2016 study also predicted that parts of the Southwest could experience more than 200 "black flag" days a year.[79]

THE U.S. DEPARTMENT OF DEFENSE RECOGNIZES CLIMATE CHANGE AS A SECURITY THREAT

From January 2017 to January 2020, at least thirty-five senior officials from the U.S. Department of Defense (DoD) have publicly raised concerns about, and recommended actions to address, the security implications of climate change, both due to its effect on military infrastructure, readiness and operations, and its broader geostrategic implications for the United States.[80] In response to a request from Congress in the Fiscal Year 2018 National Defense Authorization Act, DoD prepared a brief report in which it once again recognized climate as a security threat. Specifically, the Department stated:

> *"The effects of a changing climate are a national security issue with potential impacts to Department of Defense missions, operational plans, and installations. Our 2018 National Defense Strategy prioritizes long-term strategic competition with great power competitors by focusing the Department's efforts and resources to: 1) build a more lethal force, 2) strengthen alliances and attract new partners, and 3) reform the Department's processes. To achieve these goals, DoD must be able to adapt to current and future operations to address the impacts of a variety of threats and conditions, including those from weather and natural events. To that end, DoD factors in the effects of the environment into its mission planning and execution to build resilience."*[81]

The Government Accountability Office (GAO) recently examined the extent to which DoD has taken steps to incorporate resilience to extreme weather and climate change effects into installation master plans and individual installation facilities projects.[82] GAO found that some bases have taken climate threats into account in their installation and facility planning, while others have not.[83]

Of course, protecting installations against severe weather is not the only worry the military has in the face of climate change. As discussed in the section on the poles, warming has opened a new strategic landscape which will bring forces from the United States, Canada, Russia and China in much closer contact via the Arctic Ocean. The U.S. military also carries out significant humanitarian and disaster relief efforts, and these response efforts are only expected to increase as global natural disasters increase. Climate change also threatens increased destabilization in regions outside of the United States, which may put strain on deployed troops or even require U.S. military intervention. All of these threats are discussed to a greater degree in the relevant regional sections, but suffice it to say that U.S. forces could be called on to respond to climate-induced crises around the globe.[84]

A U.S. Army War College report in July of 2019 examined the implications of climate change for the United States Army. One of the overarching conclusions of the analysis was the importance of developing regular administrative and institutional structures and processes that will allow the

U.S. Department of Defense to detect, evaluate, respond to and regularly review the implications of systemic risk relevant to the Department's missions and preparedness. Large scale threats like climate change and mass migrations, it explained, are systemic risks, with emergent features not captured by the simple summation of threat-by-threat-by-threat assessments.[85] Among other recommendations, the report called for formalizing interagency coordination on climate change-related intelligence. It recommended that DoD Combatant Command theater and operational plans include climate change in existing processes like Joint Intelligence Preparation of the Environment (JIPOE), Infectious Disease Risk Assessments, and Country Cooperation Plans.[86] In 2018, the Center for Climate and Security's Climate and Security Advisory Group similarly called for climate risks to be assessed in COCOM operational plans and theater security cooperation plans.[87] In 2019, the group also called for the Director of National Intelligence to support a more robust assessment of climate and interrelated "threat multipliers" within the National Intelligence Priority Framework, and to create a Climate Security Crisis Watch Center that would "facilitate an annual, stand-alone, in-depth interagency assessment, drawing from analysis across the intelligence community and beyond, of the risks that climate change poses to U.S. national security.[88]

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SOUTH AND CENTRAL AMERICA AND THE CARIBBEAN

THE BROAD REGIONAL PICTURE OF CLIMATE SECURITY RISKS

According to the 2019 Global Risks Report of the World Economic Forum, Latin American and Caribbean countries account for only 13% of global greenhouse gas emissions. However, the region is among the world's most vulnerable to climate change according to recent studies by the United Nations Economic Commission for Latin America and the Caribbean (ECLAC) and the World Bank.[1] As summed up by the Igarapé Institute, a Brazilian think tank that focuses on emerging security and development issues:

> *"In Latin America and the Caribbean, climate change involves significant risks that affect specific areas in different ways. From the melting glaciers of the Andes to the floods in the Amazon basin, from intensifying droughts in the Brazilian cerrado (tropical savannah) to growing food insecurity in Central America, from extreme weather events in the Caribbean to shifting rain patterns in Patagonia, the entire region faces a series of emerging challenges."*[2]

These challenges add stress to already weak state institutions and fragile economies which in some contexts may lead to security outcomes that require the intervention of state security forces.

SUB-REGIONAL DISTINCTIONS

THE NORTHERN TRIANGLE: TOO MUCH AND TOO LITTLE WATER, MIGRATION AND UNREST

In recent years, millions of people have fled Central America escaping grinding poverty, violence, and institutional collapse. The dominant media narrative explaining the current Central American migration to the United States centers on traditional economic and security conditions across Honduras, Guatemala and El Salvador. However, discussions of failing economies and corrupt governments do not tell the whole story. The ongoing food security crisis across the region (caused by drought, crop disease,[3] and water shortages, all exacerbated by a changing climate), is an important background driver of political unrest and mass migration, and does not receive enough media or policy attention.[4]

For the past five years, recurring droughts have destroyed maize and bean harvests, leaving poor subsistence farmers in the so-called Dry Corridor that runs through Guatemala, El Salvador, Honduras and Nicaragua struggling to feed their families.[5] A cyclical El Niño event, which began in 2015, compounded the atypical regional dryness leading to consecutive years of crop failures. In 2015, the UN estimated that "thousands of cattle had died and up to 75% of maize and bean crops in Honduras and Guatemala had been lost in the drought," which began the previous summer.[6]

Just when communities began recovering from the 2014 drought and 2015 El Niño phenomenon, another drought descended. In 2018, the UN Food and Agriculture Organization reported that, "Recent

Dry season in Nicaragua, 19 February 2011.
The Center for Climate and Security.

drought has led to the loss of some 280,000 hectares of beans and maize in Guatemala, El Salvador and Honduras, potentially affecting the food and nutrition situation of more than two million people." FAO Regional Representative, Julio Berdegué, warned that there needed to be concern about the effect of this "new drought on migration, in an international context that restricts the movement of thousands of people who, in their localities, will have great difficulty in securing the livelihood of their families."[7]

As of 2019, the UN World Food Program (WFP) estimated that 1.4 million people living in the so-called Dry Corridor need food aid. The WFP aims to help 700,000 people in El Salvador, Guatemala, Honduras and Nicaragua, but only a fraction have yet received support.[8] A WFP survey in 2018 found that 8% of families interviewed, mostly small-scale farmers, planned to migrate because of a lack of food. This has borne out on the ground as entire families have migrated north in record numbers: since October 2018, more than 167,000 Guatemalans travelling in family groups have been apprehended at the U.S. border, compared with 23,000 in 2016.[9]

Climate change impacts also combine with other local political, societal, and environmental issues to compound problems, particularly for the most vulnerable populations, and worsen the security environment. Food security is front and center in Guatemala, which has the sixth-highest malnutrition rate in the world, with at least 47% of children suffering chronic malnourishment. Malnutrition rates are even higher among the country's 24 indigenous communities.[10] Guatemala has also lost half its woodlands in the past 40 years; as deforestation rates rise, this in turn causes floods, landslides and erosion of farmland. "It's fewer days of rainfall but more intense rainfall, sometimes harmful because it's so strong," Alex Guerra Noriega, general director of the Climate Change Research Institute in Guatemala told *NBC News* in a 2019 interview. "And then you get a few weeks with no rainfall and then you have these drought conditions and your crop fails."[11] On top of these erratic weather patterns, a deadly fungus which thrives in the sort of hot and humid conditions exacerbated by the climate crisis, has wiped out about 80% of the region's coffee crop in the past five years.[12] This has meant that the region's many migrant farmers who pick coffee cherries for a living have been unable to find work. The result of this confluence of factors is lost livelihoods on a significant scale, which is contributing to mass displacements of peoples and political instability.[13] Regarding the implications of regional insecurity for countries to the north, Richard Holwill, former U.S. deputy assistant secretary of state for inter-American affairs, noted: "National security rests on economics as well as anything…We can't just pull up a drawbridge, wall out the rest of the world and say, hey, we can survive here in this island that we call the United States. We are interconnected, and our security is enhanced by ensuring that their world is stable."[14]

The story is similar in Honduras. Like many poor, developing countries, Honduras has contributed relatively little to the greenhouse gas emissions heating the planet. Yet it is one of the places most vulnerable to climate change's effects, according to the U.S. Agency for International Development. From 1998 to 2017, Honduras was among the three most weather-battered countries in the world.[15] Parts of Honduras have seen some years with up to 40% less rain than normal, interspersed with years of heavy rainfall that washes out crops. Western Honduras is predicted to become a climate "hot spot," or an area that sees relatively more intense effects of climate change, with greater temperature increases than the rest of Central America. Agriculture employs almost one-third of the Honduran population, and this extreme and unpredictable weather makes farming challenging. Not surprisingly, the Honduran government declared an emergency in the summer of 2018 due to food shortages, joining El Salvador and Guatemala, which issued similar alerts.[16] Researchers and international aid workers say that for small family farmers in the region to survive, they need support to adjust to the climate's rapid changes, including instruction in planting drought-resistant crops and help conserving water.[17] The U.S. sends hundreds of millions of dollars in assistance to Central America every year, but most of it gets directed to security, drug control or violence prevention programs, rather than agricultural or environmental support. The unfortunate irony is that the lack of support for the latter programs could undermine the peace and security issues addressed by the former.

Water is a driving force in El Salvador as well. El Salvador is the most densely populated country in Central America. It also has the region's lowest water reserves, which are depleting fast due to the climate crisis, pollution, and unchecked commercial exploitation. According to one study, El Salvador will run out of water within 80 years unless radical action is taken to improve the way the country manages its dwindling water supplies.[18] In recent years, widespread water shortages have helped fuel political unrest and forced displacement in El Salvador. Years of drought have prompted water rationing in urban and rural areas across the country. Yet much is wasted: most rainwater is lost due to widespread deforestation and eroded river basins; once in the system, 48% of water is lost through leaks. "Marginalized communities struggle day to day to get access to enough water. It's not a question that this could one day cause social conflict – it already is … the whole country is close to crisis," Silvia de Larios, the former director of ecosystems and wildlife at the ministry of environment and natural resources, told The Guardian in a 2019 interview.[19]

Over a decade ago, the Migration Policy Institute explained that an under-recognized "factor influencing rural-to-urban migration is environmental degradation," and that "declines in small-scale farming also induce peasants to leave the countryside for capital cities."[20] Though primary migration flows in the region are internally oriented (i.e. rural to urban), once unemployed farmers and their families arrive in Central American cities, they often find little-to-no employment opportunities, as well as warzone-like crime rates (El Salvador's murder rate hovers around 81 killings per 100,000, more than ten times the global average). Not being able to establish themselves in crime-ridden cities compels so-called "drought refugees" to make the trek north. The "step migration" staircase often ends at the doorsteps of the United States, where Central American families, and in many cases, unaccompanied minors, show up seeking refuge and a fresh start. Barring significant investments in climate-resilient farming techniques and more efficient water collection and distribution, the climate crisis is only expected to lead to increased migration from the Central American "dry corridor" to the United States, and increased political unrest. [21]

United States Southern Command (USSOUTHCOM), whose area of responsibility includes all of Latin America and the Caribbean, has highlighted climate change impacts as security risks in recent years. In a 2015 report to the U.S. Congress, the command acknowledged: "...the threat that sea level rise and ocean acidification and warming pose to fish stocks, coral, mangroves, recreation and tourism, and the control of disease." The report continued, noting that the command "also identifies coastal flooding to be a particular concern for parts of the Caribbean basin due to climate change-related sea level rise."

In 2014, USSOUTHCOM completed a collaborative report on the topic of "environmental and energy challenges for military forces, including climate change" with military experts from Chile, Colombia, El Salvador, and Trinidad & Tobago, and subsequently presented its concerns about these risks to the InterAmerican Defense Board.[22] In short, many militaries in the region are aware of the security risks of climate change, and are at least attempting to plan for them.

The aforementioned climate trends superimposed on the fragilities of one of the most insecure regions of the planet, will more likely than not broaden and deepen existing security challenges. Emigration, illicit trafficking, domestic crime will all be made worse by trends that undermine the human security of the burgeoning populations of the region. States north of the region, namely Mexico and the United States, will have to manage these emigration flows in a manner that is humane and stabilizing, including managing an ever-increasing number of migrants and refugees.

SEA LEVEL RISE AND HURRICANES THREATEN REGIONAL ECONOMIC ENGINES

In Latin America and the Caribbean, 70% of the population lives in cities, and many of these cities (as well as critical infrastructure) are located in coastal areas, intensifying populations' vulnerability to climate change. According to ECLAC (the United Nations Economic Commission for Latin America and the Caribbean), the most vulnerable countries in the region based on their reliance on critical infrastructure located on the coast, are Brazil, Cuba, the Bahamas, Argentina and Mexico. (Of note, Mexico is discussed in the section on North America)[23]. In terms of affected populations, an increase of one meter in sea level would have a significant impact on Brazil's coast with major consequences for large urban clusters. In a survey conducted by the State University of Campinas (Unicamp), São Paulo state's North coast, for example, due to its ecological characteristics, is very sensitive to climate impacts, such as heavy rain. This ecological sensitivity, coupled with the state's increasing population (driven in large part by an expanding oil sector), could make the infrastructure of coastal cities in the state of São Paulo even more fragile in the face of natural disasters such as landslides and flooding.[24]

Central America is itself but a thin strip of land sandwiched between the Pacific and Atlantic oceans, and as such is particularly vulnerable to rising sea levels and associated extreme weather such as hurricanes. In Honduras, a local factor that is further accelerating coastal degradation is the destruction of swathes of mangrove forests to make way for industrial shrimp farms which have proliferated even inside protected nature reserves. Mangroves are essential to healthy, resilient coastlines. The sturdy trees protect shorelines from storms and floods, and help prevent erosion by stabilizing sediments with their intertwined roots.[25] According to the director of a local marine conservation organization in Honduras (Coddeffagolf) shrimp farms are routinely approved in protected areas and environmental

Hurricane Irma on Sint Maarten (Caribbean Netherlands) - air photo. September 2017.
Ministry of Defense, Netherlands

violations are rarely punished as officials often have vested interests in the profitable industry. "The consequences of losing this essential ecosystem are clear," local biologist Víctor Bocanegra told the Guardian. "Environmental vulnerability, food insecurity, poverty and social decomposition, which all leads to forced migration."[26]

The Caribbean, for its part, has long been tested by and exposed to a range of climate change impacts including more frequent or intense tropical storms, changing precipitation patterns (more intense rainfalls and drought), sea level rise and ocean acidification. Ocean warming and ocean acidification drive coral bleaching and coral colony death. For economies that rely on pristine beaches, coral reefs, and fishing to draw tourists to the Caribbean and sustain livelihoods, widespread coral bleaching and the collapse of marine ecosystems is a huge problem which can impact food and economic security (by decreasing marine food sources, a key source of protein), reef-based tourism, and other economic activity including commercial fishing.[27]

Caribbean populations, economic activity, and infrastructure are also concentrated in low-lying coastal areas where they are extremely vulnerable to sea level rise and storm damage. The region has already been experiencing increasing tropical cyclone intensity, with associated casualties, property damage and economic losses. Between 2016-2018 alone, a series of catastrophic storms hit the region including four Category 5 and two Category 4 storms. Then 2019 brought two more category 5 storms, one of which, Hurricane Dorian, devastated the Bahamas and was the strongest hurricane ever recorded in the open Atlantic, topping a record previously held by Hurricane Irma which in 2017 tore through Dominica and Barbuda.[28] Subpar or antiquated critical infrastructure such as water distribution networks, roadways, and electricity grids compounds resiliency challenges in the wake of ever more frequent monster storms. According to the United Nations Children's Fund (UNICEF), the number of people internally displaced by storms and flooding increased six-fold in the Caribbean in recent years. From 2014 to 2018, 3.4 million people were internally displaced.[29] In many cases, internal displacement then leads to migration. For example, after Hurricanes Maria and Irma, an estimated 123,000 people left Puerto Rico, most bound for the United States.[30]

These climate impacts are occurring in a context of underlying structural challenges across the Caribbean such as high unemployment, undiversified economies, livelihoods dependent on climate-sensitive natural resources and governance gaps that inhibit the effective rule of law. Agriculture accounts for around a quarter of employment in CARICOM (Caribbean and Common Market) countries, and the agricultural sector in the region is increasingly vulnerable to more frequent and intense droughts associated with climate change. The region also has a 400-year history of being plagued by illicit maritime smuggling, and organized crime activities including gangs and cartels.[31] Much of the Caribbean's instability and criminality are rooted in a lack of economic opportunity. Climate change will further limit economic options as Caribbean economies depend heavily on tourism, export agriculture and other sectors which are sensitive to climate impacts. The two problems are self-reinforcing: climate-linked economic contraction may undermine a state's financial resources and ability to counter criminal activities through effective policing and well-functioning justice systems. Then, a breakdown in the rule of law following a hurricane can drastically reduce tourism revenue for significant periods of time if the incident creates negative perceptions about a country's safety and stability.[32] Climate change could therefore contribute to significantly worsening the security landscape of the Caribbean, both national and international.

ANDEAN NATIONS: MELTING GLACIERS DRIVING WATER AND ENERGY INSECURITY

Another significant sub-regional vulnerability to climate change stems from a strong dependence on the Andean thaw for water supply, and related energy production. The Andes are home to more than 95% of the world's tropical glaciers. [33] In some countries, such as Peru, Bolivia, and Colombia, the glaciers are a critical source of water—for drinking, hydropower, and agriculture. High-mountain "water towers" act like giant storage tanks. Snow falls, filling a sort of metaphorical tank, melts out

The Piedras Blancas glacial lake in Patagonia in Santa Cruz province, Argentina. David Silverman/Getty Images

slowly over days, weeks, months, or years, like a natural valve that smooths out the water flow. This consistent flow matters for those who live in the high mountains because slow, steady melt is less destructive than big rain events, which can cause flash floods or landslides. Consistent water flow is better for farmers both upstream and down, who rely on steady or at least predictable water supplies. It is also important for cities and towns, which need water year-round, and for the natural world, since the high mountains are home to about a third of Earth's land-based biodiversity.[34]

Andean glaciers across the region have been in rapid retreat since the 1970s, and in some cases have virtually disappeared. Bolivia is one of the countries that suffers most from glacial melting; glaciers provide 15% of Bolivia's capital La Paz's yearly water supply and Glacier Chacaltaya has virtually disappeared. In Peru, the population of the Rio Santa valley is similarly considered one of the most affected populations, depending on glacial waters for agriculture, domestic consumption and hydropower.[35] Venezuela is also a frontrunner in a somber race (along with Tanzania and China) for which country will lose its glaciers first. This phenomenon has largely gone unnoticed and undocumented amidst the political and economic upheaval Venezuela has suffered in recent years, but the country's Humboldt Glacier is expected to melt away in the next decade or two without scientists ever having fully studied it.[36]

Climate change is hitting high mountain regions hard. The high mountains contain about half of all the freshwater humans use. New research published in December 2019 in Nature identifies the most important and vulnerable high mountain "water towers" in the world. In South America, the South Chile water tower along the Pacific Coast serves 7 million people in Chile and Argentina. The South Argentina water tower along the South Atlantic Coast serves 400,000 people in Chile and Argentina,[37] and the Negro water tower serves 1 million people in Chile and Argentina. "In the past, mountains were not seen as one of the key parts of the earth system, like tropical forests or oceans," says Walter Immerzeel, a mountain and climate scientist at the University of Utrecht and the lead author of the report. "But now we are recognizing them as just as important."[38] The social, economic, political and security consequences of these critical mountain water sources being threatened are almost too significant to articulate. Though in the past, water stress sometimes precipitated cooperation between conflicting parties, intelligence projections under plausible climate change scenarios paint a picture of an increased likelihood of international and intranational conflict over such diminishing water resources.[39]

Adaptations are emerging, though it may not be enough given the rapidity and scale of change. For example, as one of the vulnerable Andean nations that relies on the high mountains for water, Peru is turning to natural, ancient water systems to better manage diminishing water supplies. The Incas and others figured out ways to divert some wet season rains and effectively save this water for the long dry season. In a few Andean villages, people still use this 1,400-year-old technique to capture rainfall in shallow canals called amunas and route the water to sandy, rocky places where it will soak into the ground. Because water moves more slowly below ground than on the surface, the captured rainfall emerges sometime later from underground springs, effectively shifting water availability into the dry season. Now, researchers have measured and modeled how restoring and using additional amunas—which exist in different parts of the Andes highlands, although many have been abandoned—could help Lima, the second largest desert city in the world.[40] With a population of almost 10 million, Lima has dams and reservoirs to help it through the dry season, but the city still falls short. Researchers have calculated that by diverting 34.7% of wet-season stream flows into amunas, the city could have access to double the current annual shortfall of water in the dry season.[41] Restoring additional amunas

throughout the mountains above Lima will likely prove even more valuable as natural water storage features such as glaciers and snowpack disappear with climate change.

Peru is a world leader in laws and policies that support using natural ecosystems to provide humans with critical resources such as water. Public water utilities there set aside a percentage of their fees to pay for nature-based water protection. Also, climate change is altering patterns in Peru, tending to make wet seasons wetter and dry seasons drier. As water managers adapt to this new reality, building expensive, big dams is not the answer. A solution like amunas costs about one-tenth that of gray infrastructure, said Boris Ochoa-Tocachi, lead author of the study and a civil engineer at Imperial College London.[42] Restoring the amunas over a wide area would be cheaper and more of them can be restored as needed, making them a more flexible approach. The paper concluded that securing Lima's water future will likely mean a hybrid approach of using ancient and modern technologies, as well as nature. Whatever the approach taken in Lima and elsewhere in the Andes, if scenarios of widespread water shortages come to pass the economic and security challenges will be enormous if solutions are not implemented in time.

Colombia provides a powerful example of how creative application of climate policy to seemingly unrelated challenges can solve intractable conflicts. The Colombian Peace Agreement was the first in history to have climate, sustainability, and rural economic development as core principles. The Revolutionary Armed Forces of Colombia (FARC) had controlled vast swaths of the Colombian rainforest for decades, essentially keeping them off limits to economic exploitation and development. Recognizing that unsustainable logging, resource extraction and slash and burn agriculture were likely to devastate a critical global carbon sink if the FARC were to disband, the Colombian government sought to enlist those most invested in preserving its forests. Northern European nations led by Norway had invested billions in rainforest carbon offsets. Bogota brought them into the peace process as highly capable, well-funded stakeholders. Additional financial commitments by the Europeans are helping to underwrite sustainable implementation of the accords. In 2017, Colombia instituted a nation-wide carbon tax to in part pay for FARC reintegration.

VENEZUELA: CLIMATE CHANGE AND POLITICAL INSTABILITY

According to Venezuela's Ministry of Electricity, between 2013 and 2016, Venezuela's rainfall measured 50% to 65% lower than normal. This rainfall deficit left the country dry and dramatically reduced Venezuela's capacity to generate electricity via its hydroelectric power generators. The shortage of water in reservoirs led to the government imposing rolling blackouts and water rationing in 2016, compounding the stress already felt by the majority of Venezuelans due to the economic contraction and its attendant food crisis.[43] According to Circle of Blue (an international network of journalists and scientists focusing on the global freshwater crisis), the electricity outages and water rationing affected "every industry and [were] a factor in the country's slipping economy, soaring inflation, and food and supply shortages."[44]

The protracted dry spell darkened every corner of national life at a time when many Venezuelans had already started to feel the acute impacts of intensifying food insecurity (including malnutrition). An underperforming agriculture sector, featuring a 60% decline in the domestic production of rice, corn and coffee since 2007, already had the nation of 32 million teetering on the edge of disaster in 2013 when drought effects started to be felt. As household pipes ran dry, Venezuelans didn't blame climate change, they blamed the Maduro government. While a drought placed pressure on the country, it was

Exposed Water Height Marker and reservoir in dead volume during the 2016 Drought. Açude do Cedro, Quixadá - CE , Brasil. September 2016. Euclides Gabriel Brito Medeiros

the Maduro government's approach to handling it, and many other social, political and economic ills, that drove so many Venezuelan citizens to call for change.[45]

Thousands of Venezuelans fled the country, heading to Colombia, Brazil, Ecuador, Peru and the Caribbean. According to Andrew Holland, Chief Operating Officer of the American Security Project, "People [were] leaving because [Venezuela is] a failed state, but one of the symptoms of being a failed state is not being able to adapt to these changes in your environment."[46] Venezuela's government hadn't added enough capacity to the electrical grid to allow it to cope with disruptions at its hydroelectric dams, and critics also blamed the government for failing to properly maintain it. When Venezuelan refugees arrived in countries around the region, climate change played a role in that story, too. Some areas of Colombia and Brazil where Venezuelans took refuge had also experienced drought, and the newcomers added to the demands on already strained water resources. According to some UN experts at the time, Venezuelan refugees exacerbated the depletion of the water table in northern Brazil.[47] If receiving populations perceive that incoming refugees are deepening competition for vital resources, or even for jobs, then tension and even violence can ensue, as was seen in northern Brazil in clashes with Venezuelan refugees in 2018.[48]

Like many nations, Venezuela is rife with internal contradictions. On one hand, Venezuelan delegates to UN climate talks have long argued that the global north is to blame for warming and should pay damages. Meanwhile, the nationalized petroleum sector produces some of the world's dirtiest crude oil: A 2018 Stanford University study estimated it was on average six times more carbon-intensive than Saudi product.[49] At the same time, Venezuela is among the most biodiverse nations in the world. But it has become increasingly difficult to assess and protect the nation's environment as the federal government spreads a cloak of secrecy over environmental and scientific statistics. In 2012, the federal government officially discontinued publishing its index of national fishing production, along with a list of beaches suitable for human use. Since then, many other important environmental indices have been hidden from public view. This trend toward data secrecy has greatly intensified under the government of Nicolás

Maduro, with many negative impacts. Many important government environmental and social indices have been hidden from public view, including data on deforestation, wildlife endangerment, water and air quality, climate change, energy, national fisheries and more.[50] The concealment of national data on the environment means that researchers, regulators, NGOs, activists, courts and other institutional bodies no longer have baseline data against which to measure or to forecast and adapt to climate change.

Compounding governmental restrictions on transparency are difficulties in collecting scientific data in a nation suffering economic and social freefall. For example, 70% of Venezuelan weather stations are inoperative, meaning that regional temperature and rainfall patterns are no longer being measured.[51] Venezuelan scientists lament that nonexistent funding, deteriorating equipment and the country's worsening political turmoil have made research virtually impossible. They struggle to find food and maintain personal security, let alone conduct research. As a result, many scientists have fled to other countries where they often end up in non-science jobs to make ends meet.[52] In the climate science sphere, in the face of the lack of official data and Venezuela's failure to produce several UN NCCCs, the nation's Academy of Sciences offered its own report on climate forecasts and efforts in the country. But this report was badly hampered by the fact that, "Of the 63 researchers [originally] cited [in past reports] less than half attended the last review because they had left the country," explained biologist Alicia Villamizar, a member of the UN Intergovernmental Panel on Climate Change, and Secretary of Climate Change for Venezuela's National Academy of Sciences. [53]

Given this unraveling of the Venezuelan economy, and even its scientific community, it is hard to see how the nation could step up to effectively address its climate security challenges. A more likely scenario is that as climate and other challenges mount, migration will continue leading to cross-border tension with neighbors, and a further deterioration of internal conditions.

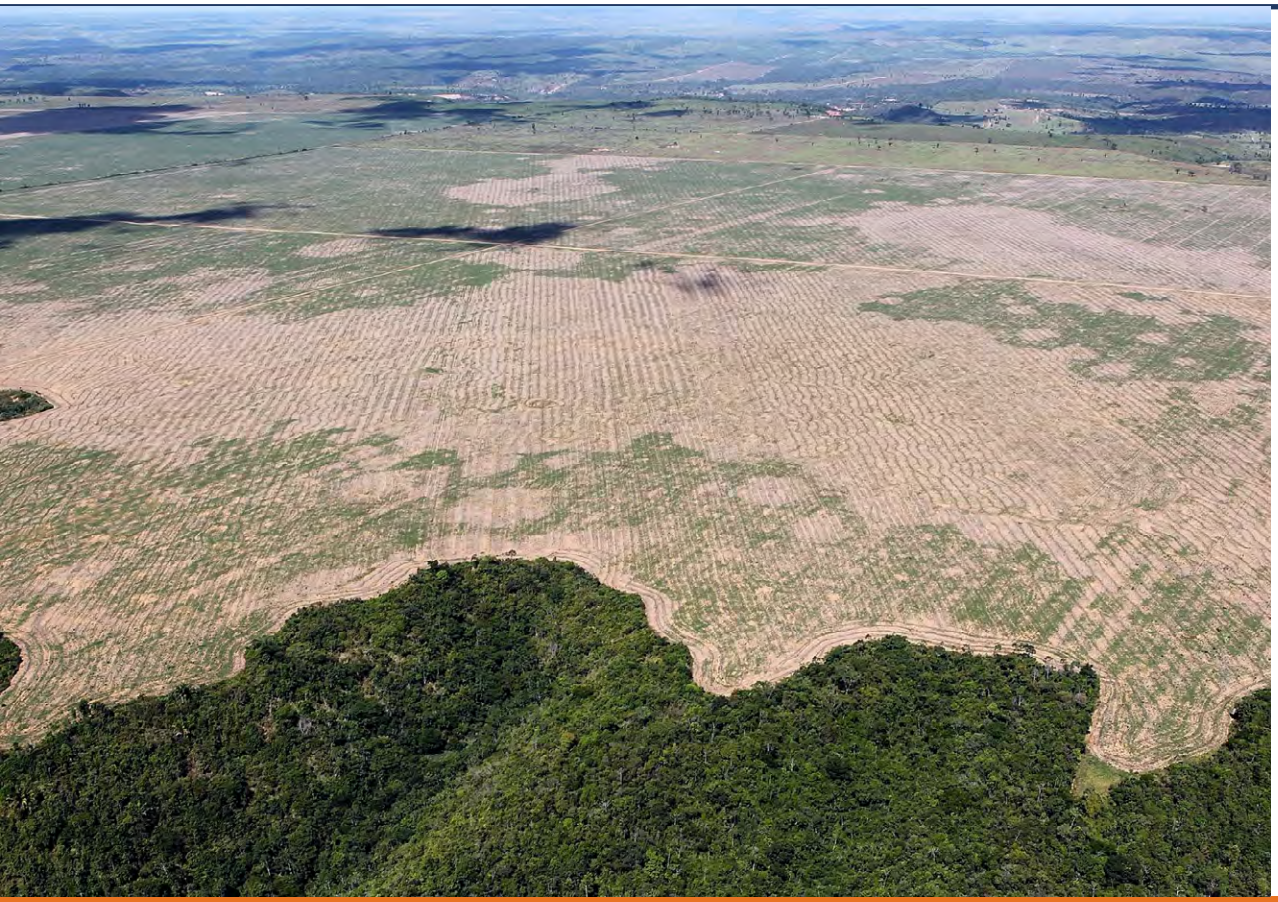
BRAZIL: WATER WOES, WILDFIRES AND SECURITY

Brazil's population is roughly 50% of the total population of South America. The country has the world's sixth largest economy, and São Paulo, Brazil, is home to over 20.1 million people. This behemoth of a nation finds itself increasingly impacted by environmental variability, principally in the form of too much or too little water.

Brazil has been lauded internationally for its efforts to leverage its ample natural water flows to produce hydro-electric energy. The costly effort has been transformational and today about two-thirds of Brazil's power grid relies on hydroelectricity. A predominantly hydro-electric grid was meant to insulate the Brazilian economy from high global energy prices while creating one of the greenest economies in the world. But in eliminating some vulnerabilities, the "hydro" transformation has introduced a new set. When the country suffered what was described as its worst drought in 100 years from 2014-2017, the water shortage affected water supplies and also put the electrical system under strain. Over 15,000 protestors stressed by the water crisis in São Paulo took to the streets. Then, as anxiety spread about water rationing, some São Paulo residents began stockpiling water in open containers, leading to a surge in dengue fever.[54]

To be fair, as stated in an April 2015 Fortune magazine article, if any nation could have been justified in being complacent about its water supply, it was Brazil. A country known for its lush and vast rainforest and the most voluminous river in the world, the Amazon, once feared being persistently flooded by its overflowing rivers and storms. Water scarcity was not a top of mind concern. To the contrary, Brazil's vast natural water reserves appeared perfect for producing abundant and reliable "green" hydro electricity.[55] But the lengthy and record-breaking drought of 2014-2017 has cast this strategy into doubt.

The more well-known climate issue associated with Brazil is, of course, deforestation. But what is not much talked about is deforestation's impact on energy production. This link between deforestation and Brazil's energy supply comes down to disruption of the water cycle. Antonio Nobre, a leading climate scientist at INPE, Brazil's National Space Research Institute, explained that global warming and deforestation in the Amazon have and will continue to drastically reduce - to the tune of billions of liters of water - the water released by rainforest trees. This reduction in transpiration, as the process is called, results in less rainfall in the south of the country, rainfall that is needed to power hydroelectric dams.[56] Brazil depends more on renewable energy sources (including biofuels) than any of the world's other large energy consumers. In particular, in 2018, about 65% of its electricity came from large hydropower plants, and more than 15% came from wind, solar, and biomass. As precipitation and water flow become more and more erratic with the effects of climate change, Brazil may have to lessen its reliance on hydroelectric power and install more wind and solar projects.



Deforestation in Gurupi Biological Reserve and the Caru and Alto Turiaçu Indigenous Lands, in Maranhão. July 2016.
Felipe Werneck /Ascom/ Ibama.

Beyond electricity, due to Brazil's size and scope of influence, protracted water stress in the country has implications across the globe. Brazil is the world's leading exporter of soybeans, coffee, orange juice, sugar and beef, and the third largest agricultural producer in the world overall.[57] [58] Irrigation for farming accounts for around 72% of water use in Brazil, compared to just 9% for urban consumption. The Agricultural Economy Institute estimated that because of the drought in 2014 São Paulo state suffered its worst agricultural losses in half a century.[59]

As stated above, the climate issue that is most associated with Brazil is, of course, deforestation of the Amazon rainforest. The Amazon rainforest spans nine South American nations, with 60% of it located in Brazil. Reducing deforestation is the most important contribution Brazil can make to global climate health. Under the Paris climate agreement, Brazil committed to eliminating illegal deforestation in the Amazon and reforesting 12 million hectares by 2030. The country's efforts in this respect matter on a global scale: The Amazon is estimated to contain 10% of the world's biomass, absorbing and storing massive amounts of atmospheric carbon dioxide. In 2015, 46% of Brazil's greenhouse gas emissions were caused by land use changes, such as deforestation and increases in croplands, and the huge decline in Brazil's emissions between 2005 and 2012 was owed mostly to a reduction in deforestation. This suggests that progress is possible, but the rise in deforestation since 2012 means Brazil has to do more.

Going forward, if another protracted drought leads to a water (and possibly an energy) crisis like the drought of 2014-2016, the government could face a great deal of internal pressure and mounting social unrest in addition to international pressure to regain its leadership position on climate. If wildfires of the scale seen in 2019 affect the country again, and the government is seen as unresponsive (and having not done enough preventively), the implications for social and political stability could be serious for both Brazil and its neighbors. [60]

REGIONAL SECURITY INSTITUTIONS: RISKS AND RESPONSES

Regional security organizations, and champion countries for the region, are beginning to more robustly engage on climate change and security issues. Civil society, business communities, and most legislatures around the region now understand the serious impacts climate change is having and will increasingly have across their economies and societies. All states in the region (minus Nicaragua) signed the Paris Agreement and the majority have expressed their commitment to curb carbon emissions. In June of 2019, the Inter-American Defense Board (IADB), a component entity of the Organization of American States, held a conference led by the Chilean military titled "Climate Change and its Impact on Security and Defense."[61] In January 2019, the Dominican Republic led a debate at the UN Security Council on the implications of climate disasters on security in January 2019.[62] Nauru teamed up with Germany to establish the "Group of Friends on Climate and Security" in August 2018,[63] and the Caribbean Disaster Emergency Management Agency (CDEMA) and its partners, including the Center for Climate and Security, the Clingendael Institute and the Aruba Centre of Excellence for Sustainable Development of Small Island Developing States, hosted a regional consultation in Aruba titled "Climate and Security in the Caribbean Region: A Roadmap to Resilience," which brought together experts, practitioners and policymakers to discuss climate change and its effect on security across the Caribbean region.[64]

However, the defense and security domains have yet to join the discourse in ways that demonstrate a serious appreciation of the severity of the risks posed by climate change not only to military facilities, but also to national, regional and global law and order processes of which they are important stakeholders.[65]

The linkages between climate change and security/military equities are complex, but they fall into two broad categories. The first are risks to military/security installations, facilities and operational readiness such as the risks posed to military infrastructure. The second category are risks of that climate will contribute to causing the kinds of crises that may demand a military/security response. These crises could be natural disasters, or a broader range of scenarios such as mass migration or even conflicts over resources.

The first category of risks should be of immediate concern to regional military/security leadership since climate impacts such as sea level rise, wildfires, flooding, and extreme weather can gravely harm militaries' vital infrastructure – ports, bases, and facilities. In Colombia, for example, in August 2018 a wildfire broke out — the second in a month — at the Colombian Military Forces' Tolemaida base, burning more than 340 acres and impacting infrastructure and training.[66] In addition to drought and wildfire risks, many Latin American and Caribbean bases, like others around the world, are located along coastlines, and across extensive riverine environments, so exposure to sea level rise, glacial melt, and extreme weather risks are already significant, and should be taken more seriously.[67]

Phenomena like drought and sea level rise are slow-moving trends that military organizations in the region traditionally do not consider to constitute security related issues, though that has been changing in recent years. Therefore, addressing these risks are generally not seen as part of their military responsibilities.[68] Nonetheless, if not addressed, these non-traditional risks not only threaten peace and stability in the region, but will also significantly affect the facilities where armed forces plan,

Military personnel from over 13 Latin American countries attend the seminar in Dominican Republic, May 2019. FA-HUM 19 is a U.S. Army South-sponsored foreign humanitarian assistance and disaster relief exercise designed to build U.S. partner nation's capacity for civil and military response to major disasters. U.S. Army / Spc. Miguel Ruiz

train, and launch operations.[69] "The armed forces, particularly navies, should carry out studies of their barracks and infrastructures, since coastal military installations at sea level are likely to be victims of the rise of the ocean. As such, military commanders should set up equipment that can study long term naval infrastructure plans, such as fuel bases, power plants or marine shipyards," said Commander (ret.) Patrick Paterson, professor of Security Studies at the William J. Perry Center for Hemispheric Studies, in his 2017 report Global Warming and Climate Change in South America.[70]

Beyond operational and readiness risks related to military facilities, any number of scenarios could require that the military be deployed as "first responder" and "peacekeeper" either nationally, regionally or around the globe. One real-world example came in the summer of 2019 when Brazil deployed aircraft and troops to help get fires in the Amazon under control. Seven Brazilian states requested military assistance with the fires, and Justice Minister Sergio Moro also ordered the deployment of security forces to tackle illegal deforestation in the region.[71] Brazil's military deployment to address the Zika outbreak[72] - the severity of which has been tied to climate change[73] - also clearly demonstrates how climate factors can affect the role of militaries.

United States Southern Command's (SOUTHCOM) Environmental Security office has led some efforts to sensitize regional militaries to these environmental security risks and funded National Preparedness Baseline Assessments that include a gap analysis and a five-year plan to build capabilities and capacities within the countries of the region. Some multilateral training in the foreign humanitarian assistance and disaster relief mission sets is conducted in the region. For example, hundreds of servicemembers from 13 Latin American country militaries participated in a SOUTHCOM-led combined exercise - FAHUM 2019. The foreign humanitarian assistance and disaster relief exercise was designed to build capacity for civil and military response to major disasters. While armed forces of the region increasingly participate in FAHUM and other combined training and exercises based on natural disaster scenarios, more needs to be done to prepare for rapid climatic changes and how those changes are likely to disrupt military capabilities and facilities,[74] as these trends pose broader security threats.

Overall, there has been little progress in sensitizing Latin American military institutions, and key security leaders, to the threats posed by deforestation specifically, and climate change. As a consequence, current security sector policies and strategies do not give due consideration to environmental factors in security affairs for several reasons. Chief among them are: 1) Biases towards traditional threats/challenges; 2) A resistance to "non-traditional" security risk narratives; 3) Political sensitivities surrounding climate change matters; 4) National authorities and institutional doctrines that restrict how resources can be spent; and 5) Lack of policy-ready climate information that can be integrated into security policy/strategies. Imbuing a broader and richer understanding of climate risks across regional security communities will require more energetic advocacy by academics, analysts and activists to elevate the region's policymaking and security communities' understanding of the risks, and the consequences of inaction.

Few regional military leaders have publicly acknowledged, much less advocated for, climate change risks to be addressed in formal defense plans or strategies even though there is a growing body of evidence-based research that indicates that climate change was a contributor to recent crises, and which forecasts that climate-driven outcomes could increasingly require military involvement. Because of these forecasts, it is paramount that regional militaries begin to acknowledge the security risks in formal threat assessments and the strategic plans that they inform. One hopeful note comes from the

Caribbean where in December of 2018, the Caribbean Disaster Emergency Management Agency (CDEMA) hosted a climate-security event in Aruba to facilitate dialogue concerning underlying Caribbean security risks that are likely to be exacerbated by climate change. This event resulted in the outline of an Action Plan for advancing the climate resilience agenda from a climate security perspective and serves as a representative example of growing appreciation of the nexus of traditional security threats, and climate change stressors."[75]

Regional defense departments/ministries should be encouraged to participate in the climate security discourse to learn more about what the research says about the impact of environmental trends on military infrastructure and operating contexts. A next step to these kinds of exchanges should be regional assessments/studies that examine precisely how these trends are likely to change the demands made on military forces. It is noteworthy and relevant to share that the United States' Department of Defense released a climate change study in January, 2019 stating that the majority of U.S. military installations are at risk, specifically, 53 of the 79 for flooding; 43 of the 79 for drought and 36 of the 79 from wildfires. It would be helpful for regional bodies such as the Inter American Defense Board to commission similar studies as a means to spur debate and action. Country and region-specific plans and strategies that enable climate sensitive responses, commensurate to the forecast threats, would then be natural outcomes of new knowledge and would also be implemented in concert with those of civilian authorities. Taking these kinds of actions in the near term will ensure that regional militaries stay ahead of the risks and demonstrate to the hemisphere's increasingly climate vulnerable populations that the armed forces are being proactive in their role of national security guardian.

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II. CLIMATE SECURITY RISK PERCEPTION SURVEY RESULTS

SURVEY DESIGN, ADMINISTRATION AND ANALYSIS BY:

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Co-Founders and Research Directors
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Senior Advisors and Managers
The International Military Council on Climate and Security

10 HIGHLIGHTS

1. Description: Analysis of survey results measuring perceptions of climate change risks to global security among 56 international security and military professionals with knowledge of climate risks to security

2. Most respondents perceive that climate change effects on the following phenomena will present a significant or higher risk to global security in 2040:

- Water security: 98% of respondents
- Migration and natural disasters: 96% of respondents
- Food security: 94% of respondents
- Conflict within nations: 86% of respondents
- Conflict between nations: 79% of respondents

3. 93% of respondents perceive that climate change effects on water security will present significant or higher risks to global security in 2030, and 91% see those risks as severe or catastrophic in 2040. 80% see severe or catastrophic risks from natural disasters in 2040.

4. 88% of respondents perceive that climate change effects on critical civilian infrastructure would present significant or higher risks to global security in 2040, and 77% say the same for 2030.

5. 80% of respondents perceive that climate change effects on conflict within nations would present significant or higher risks to global security in 2030, and 66% see those risks as severe or catastrophic in 2040.

6. 13 of the 22 climate security phenomena assessed in the study are considered by 80% of respondents as significant or higher risks to global security by 2040.

7. 100% of the climate security phenomena assessed will increase from 2020-2040 - many dramatically – according to security and military respondents.

8. 70% of respondents identified climate change-exacerbated stresses to peace and security agreements as a significant or higher risk to global security by 2040.

9. Perceptions oof threats to "security institutions" is lower than threats to the broader security environment and infrastructure, yet: 57% of respondents still identify shifts in alliances and balance of power due to climate change disruptions as a significant or higher risk to global security by 2040, and 48% identify military mission failures due to cascading climate-exacerbated threats and disasters as "significant" or higher risks in that timeframe.

10. Critical ecosystem loss, increases in the tempo and scale of natural disasters, decreases in water security, and increases in involuntary migration, are identified as the top 4 climate change-driven risks to the global security environment.

INTRODUCTION

Climate change is already shaping the global security environment and will continue to do so for the foreseeable future. The IMCCS Expert Group's Climate Security Risk Perception Survey aimed to assess the perceptions of these risks among a select group of security and military experts and practitioners from across the globe, most of whom are familiar with climate security dynamics as either practitioners or analysts, and many of whom are IMCCS Participants, Observers or members of its Leadership. Specifically, this survey assessed their perceptions on how these changes will affect global security over three time periods: 1 year from 2020, 10 years from 2020 and 20 years from 2020. For efficiency, how these changes affect global security is referred to as "climate security" phenomena throughout this analysis. For the purposes of this survey, "climate security" phenomena were defined as "climate change-exacerbated events that affect global security, including the security environment, security institutions or security infrastructure." The survey did not assess opportunities for mitigating these risks. That will hopefully be the role of policymakers who read the results.

Respondents were asked to evaluate what "level of risk" to global security (from minimal, moderate, significant, severe, and catastrophic) presented by 22 distinct, yet interrelated climate security phenomena across the three timeframes. These phenomena were categorized under three "types" of effects: **Effects on the Security Environment; Effects on Security Infrastructure; and Effects on Security Institutions** (see Table 1 for a breakdown of the climate security phenomena under these categories).

TABLE 1

CATEGORIZATION AND DESCRIPTION OF "CLIMATE SECURITY" EFFECTS		
CATEGORY OF EFFECT	*CLIMATE SECURITY PHENOMENA*	*DESCRIPTION*
Effects on the Security Environment: Climate change-related effects on the natural environment, including on the availability of natural resources, that have the potential to scale up to higher-order security risks such as state instability, state failure, interstate tensions, conflict, and military interventions.	Water	Climate change-driven decrease in water security: Risk of sea level rise, droughts, flooding and rainfall variability driving decreases in the availability of freshwater, and contributing to social and political unrest
	Food	Climate change-driven decrease in food security: Risk of increased frequency and intensity of extreme weather events contributing to the devastation of critical harvests, affecting the price and availability of essential food staples, and contributing to unrest
	Health	Climate change-driven decrease in health security contributing to mass death: Risk of decrease in health security due to the expansion of disease vectors and increase in extreme heat, contributing to mass death
	Economy	Climate change-driven disruptions to regional and global economic security: Risk of increase in severe weather impacts on food, water and energy systems disrupting regional and global economic security
	Disaster Tempo	Increased tempo and scale of natural disasters due to climate change: Risk of increase in tempo and scale of natural disasters, including simultaneous disasters or disasters in rapid succession, that significantly strain response capacity and increase the likelihood of social and political unrest
	Ecosystem	Climate change-driven critical ecosystem loss: Risk of rapid changes to the climate driving mass biodiversity loss and extinction, and contributing to critical ecosystem loss that undermines food, water and land systems that are essential for human security
	Geo-Engineering	Unilateral geo-engineering actions intended to reverse climate change: Risk of unilateral geo-engineering actions by nations and non-state actors, designed to reverse climate change, causing unpredictable disruptions to the global climate with uncertain security consequences
	Unanticipated	Unanticipated risks: Risk of unanticipated and abrupt climate discontinuities and secondary surprises that may have unknown and serious implications for security
	Populated	Recurring climate change-driven stresses to highly populated areas: Risk of increase in climate change-driven stresses to highly populated/critical areas – e.g. megacities, financial/political centers – such as sea level rise, flooding, drought and extreme heat

(CONT.)	Territorial	Climate change presenting direct existential territorial threats to nations: Risk of direct existential territorial threats from climate change, such as the loss of small island nations and coastal zones due to sea level rise, and/or the creation of uninhabitable spaces within nations due to extreme heat
	Migration	Increase in forced displacement or involuntary migration exacerbated by climate change: Risk of increase in the forced displacement or involuntary migration of peoples both within nations and internationally, exacerbated by increases in the severity and frequency of extreme weather events
	Conflict in Nations	Climate change-driven increases in instability and conflict within nations: Risk of increases in social, economic and political instability and conflict within nations due to climate change-exacerbated stresses to food, water and energy systems
	Conflict b/w Nations	Climate change increasing the likelihood of tensions or conflict between nations: Risk of climate change disruptions to food, water and energy systems increasing the likelihood of tensions or conflict between nations over resource issues
Effects on Security Infrastructure: Climate change-related effects on physical and virtual infrastructure whose incapacitation or destruction could have a disruptive or debilitating effect on global security.	Civilian Infrastructure	Extreme weather and sea level rise eroding critical civilian infrastructure: Risk of climate change-driven security disruptions eroding critical civilian infrastructure including energy infrastructure; communications infrastructure; transportation infrastructure; manufacturing infrastructure; emergency services infrastructure; financial centers; agriculture infrastructure; healthcare infrastructure; information technology infrastructure; water infrastructure
	Military Infrastructure	Climate change threats to critical military infrastructure: Risk of increase in the frequency and intensity of extreme weather events and sea level rise threatening critical military infrastructure, contributing to the weakening of the readiness of military forces for both humanitarian and security operations
	Transport	Changes in climate disrupting critical waterways and transportation routes: Risk of climate change-driven ocean warming and acidification changing patterns of fishing and marine transportation, affecting both commerce and international security (e.g. fish stocks moving northward in a warming South China Sea)

Effects on Security Institutions: Climate change-related effects on the missions, capabilities, legitimacy and viability of national, regional and international security and military institutions, as well as peace and security agreements.	Military Alliances	Climate change-exacerbated degradation of capabilities of key military alliances: Risk of climate change-exacerbated security disruptions contributing to the degradation of capabilities of key military alliances, and possible erosion of their missions, legitimacy and viability
	Mission Failure	Military mission failures due to cascading climate-exacerbated threats and disasters: Risk of military mission failures among nations and military organizations due to cascading climate change-exacerbated natural disasters and security disruptions
	Peace Agreements	Climate change-exacerbated stresses to existing peace and security agreements and treaties: Risk of climate change-driven disruptions to food, water and energy security driving the deterioration of peace and security agreements and treaties (e.g. water-sharing agreements, cease-fires, security treaties, defense pacts, nuclear security agreements, etc.)
	Security Institutions	Climate change-exacerbated erosion of key international security institutions: Risk of climate change-exacerbated security disruptions eroding the missions, capabilities, legitimacy and viability of key international security institutions (such as the UN Security Council, and regional security institutions, etc.)
	Int'l Alliances	Shifts in alliances and balance of power due to climate change disruptions to security: Risk of shifts in alliances and balance of power due to climate change-exacerbated disruptions to the geostrategic landscape
	Isolationism	Increased isolationism at the regional and international scale due to climate change-exacerbated disruptions: Risk of increased isolationism at the regional and international scale due to climate change-exacerbated security disruptions, driving nations to withdraw from regional and international security institutions

SURVEY RESULTS

The results of the survey indicate concerns about the security implications of climate change that range from significant to catastrophic over the next 20 years. Below are six categories of findings from the analysis of survey responses.

1. Respondents perceived climate change effects on the "security environment" to be the greatest – with many in this category rising to significant or higher levels of risks to global security in 2030, and severe-to-catastrophic levels of risk to global security in 2040. Notable examples include:

WATER SECURITY: 93% of respondents perceived that climate change effects on water security would present significant or higher risks to global security in 2030; 91% of respondents perceived that climate change effects on water security would present severe or catastrophic risks to global security in 2040.

DISASTER TEMPO: 88% of respondents perceived that climate change effects on the tempo and scale of natural disasters would present significant or higher risks to global security in 2030; 80% of respondents perceived that climate change effects on the tempo and scale of natural disasters would present severe or catastrophic risks to global security in 2040.

POPULATED: 84% of respondents perceived that climate change effects on highly-populated areas would present significant or higher risks to global security in 2030; 80% of respondents perceived that climate change effects on highly-populated areas would present severe or catastrophic risks to global security in 2040.

ECOSYSTEM: 84% of respondents perceived that climate change effects on critical ecosystems would present significant or higher risks to global security in 2030; 75% of respondents perceived that climate change effects on critical ecosystems would present severe or catastrophic risks to global security in 2040.

MIGRATION: 84% of respondents perceived that forced displacement or involuntary migration exacerbated by climate change would present significant or higher risks to global security in 2030. 82% of respondents perceived that climate effects on migration would present severe or catastrophic risks to global security in 2040.

FOOD: 82% of respondents perceived that climate change effects on food security would present significant or higher risks to global security in 2030. 80% of respondents perceived that climate effects on food security would present severe or catastrophic risks to global security in 2040.

ECONOMIC: 80% of respondents perceived that climate change effects on regional and global economic security would present significant or higher risks to global security in 2030. 71% of respondents perceived that climate effects on regional and global economic security would present severe or catastrophic risks to global security in 2040.

CONFLICT IN NATIONS: 80% of respondents perceived that climate change effects on conflict within nations would present significant or higher risks to global security in 2030. 66% of respondents perceived that climate effects on conflict within nations would present severe or catastrophic risks to global security in 2040.

FIGURE 1

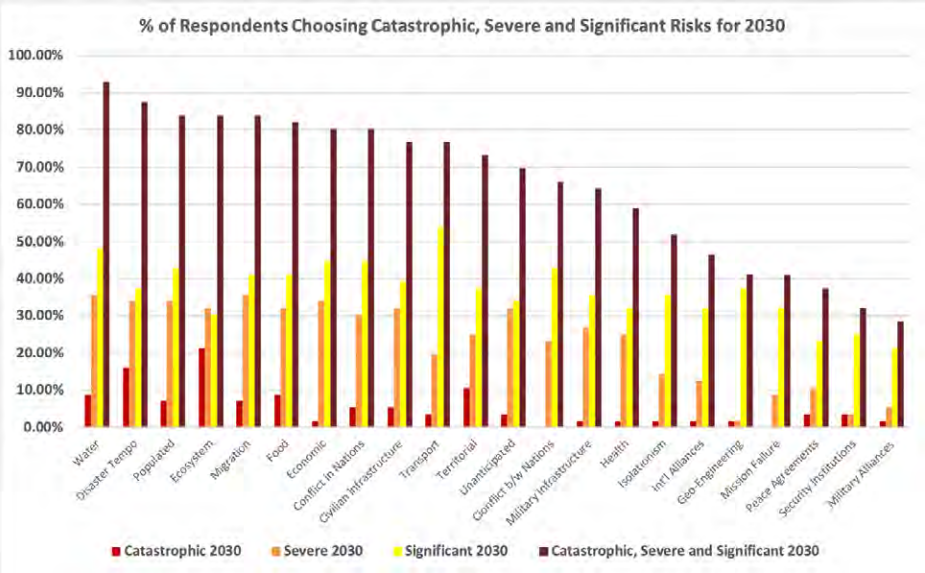
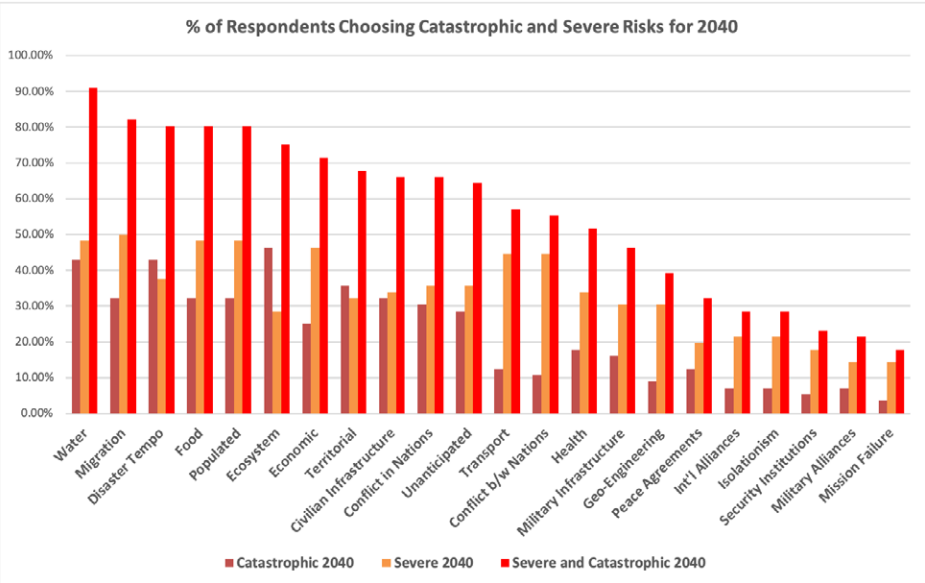
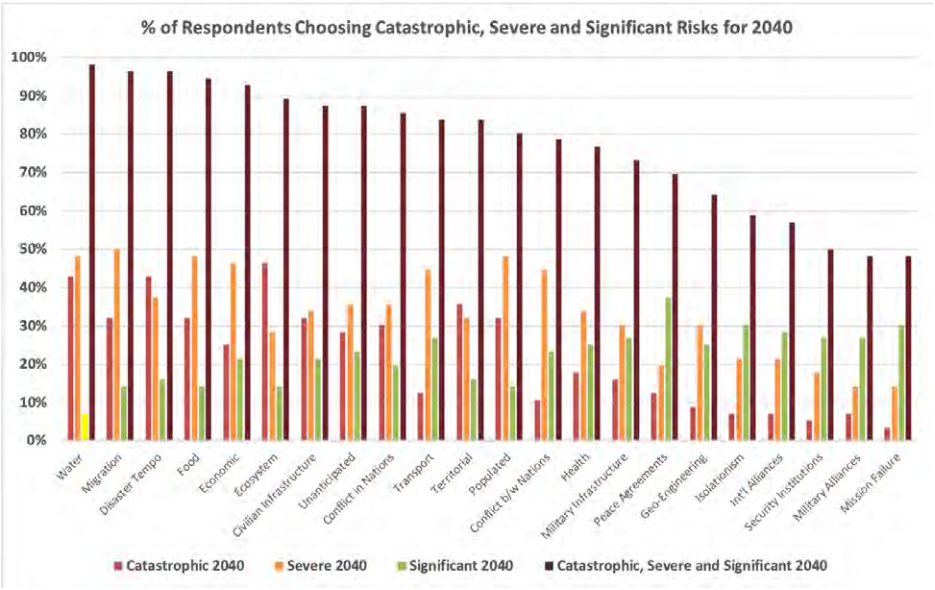


FIGURE 2



2. A majority of respondents expect all but two of the twenty-two climate security phenomena to present significant or higher risks to global security by 2040. This includes 98% of respondents choosing climate-exacerbated water security as a significant or higher risk to global security, 96% of respondents responding the same on migration and natural disasters, 94% on food security, 86% choosing "climate change-driven increases in instability and conflict within nations" to be a significant or higher risk to global security, and 79% of respondents identifying climate change increasing the likelihood of "conflict between nations" as a significant or higher risk to global security. The only two climate security phenomena where fewer than 50% of respondents perceive a significant risk or higher are "military alliances" and "military mission failures" – with both registering at 48% choosing "significant" risk or higher. Thirteen of the climate security phenomena are considered by 80% of respondents as significant risks to global security, or higher, by 2040.

FIGURE 3



3. Behind climate change effects on the security environment, respondents also identified "security infrastructure" as particularly exposed to risk, with two phenomena in this category rising to significant or higher levels of risk to global security in 2030, and severe or higher levels in 2040. See Figures 1, 2 and 3 for reference. This includes:

CIVILIAN INFRASTRUCTURE: 77% of respondents perceived that climate change effects on critical civilian infrastructure would present significant or higher risks to global security in 2030. 66% of respondents perceived that climate effects on critical civilian infrastructure would present severe or catastrophic risks to global security in 2040.

TRANSPORT: 77% of respondents perceived that climate change effects on critical waterways and transportation routes would present significant or higher risks to global security in 2030. 57% of respondents perceived that climate effects on critical waterways and transportation routes would present severe or catastrophic risks to global security in 2040.

4. Respondents perceived that 100% of the climate security phenomena identified will increase across the 20-year timescale, with many increasing dramatically. For example, in 2020, climate change-driven decreases in "water security" and "food security" were seen as severe risks to global security by just 11% and 7% of the respondents, respectively. In 2040, the picture shifts to 91% of respondents perceiving climate change effects on water security as a severe or catastrophic risk, and 80% of respondents perceiving climate change effects on food security as severe or catastrophic. Perceptions of the global security risks of climate change effects on forced displacement or involuntary migration, as well as highly populated areas, also increased significantly from 2020 to 2040. In 2020 populated areas were seen as 9% likely to have a severe impact on the security environment, migration was seen to be 4% likely to have severe and catastrophic effects on the security environment. Fast forward to 2040 and those numbers shift to 80% and 82% respectively for severe and catastrophic effects. Overall the anticipated increases in stress over the next twenty years point to a world in the midst of significant changes.

FIGURE 4

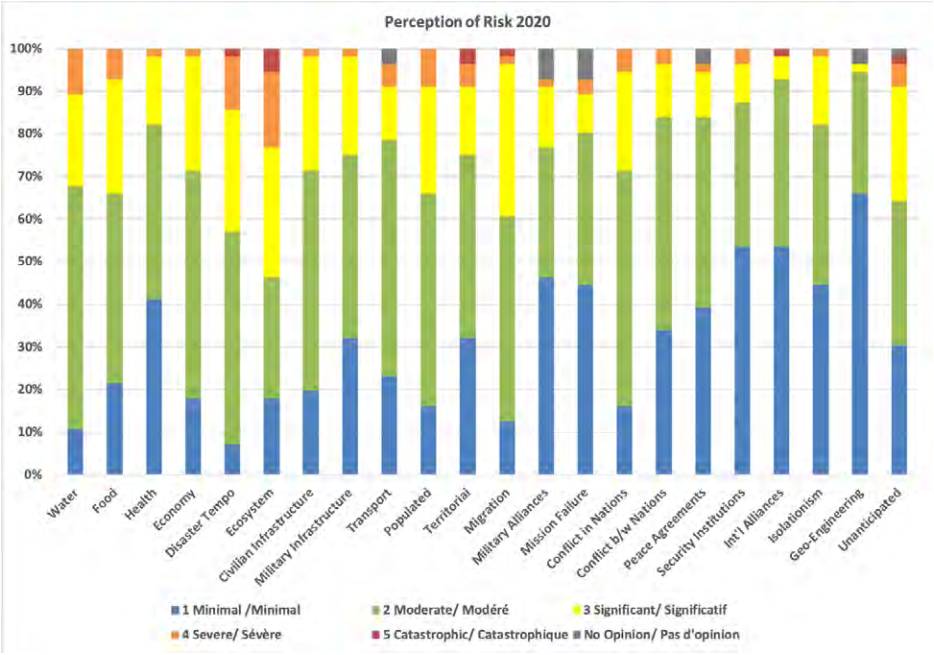


FIGURE 5

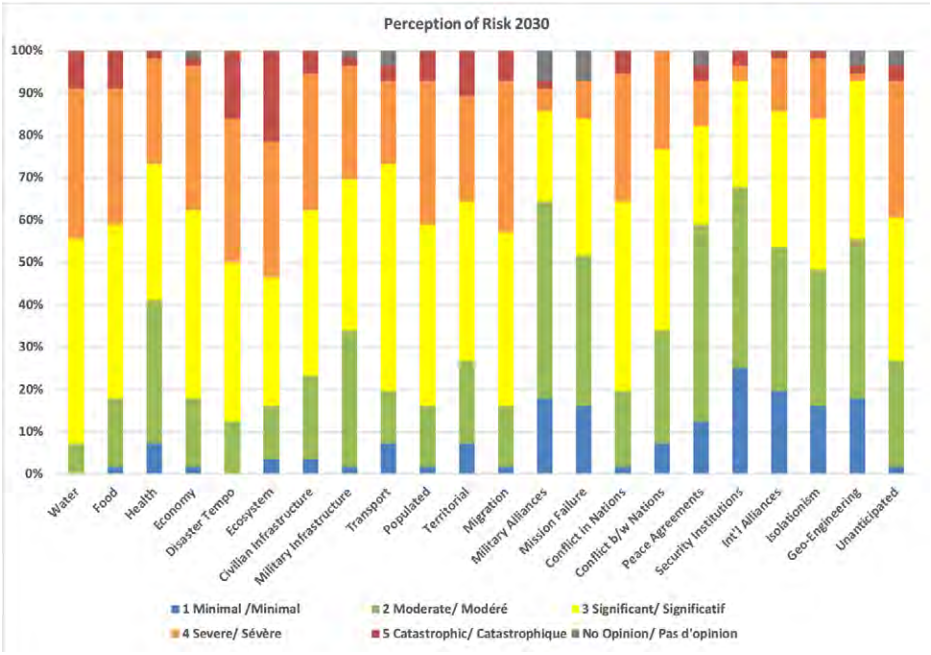
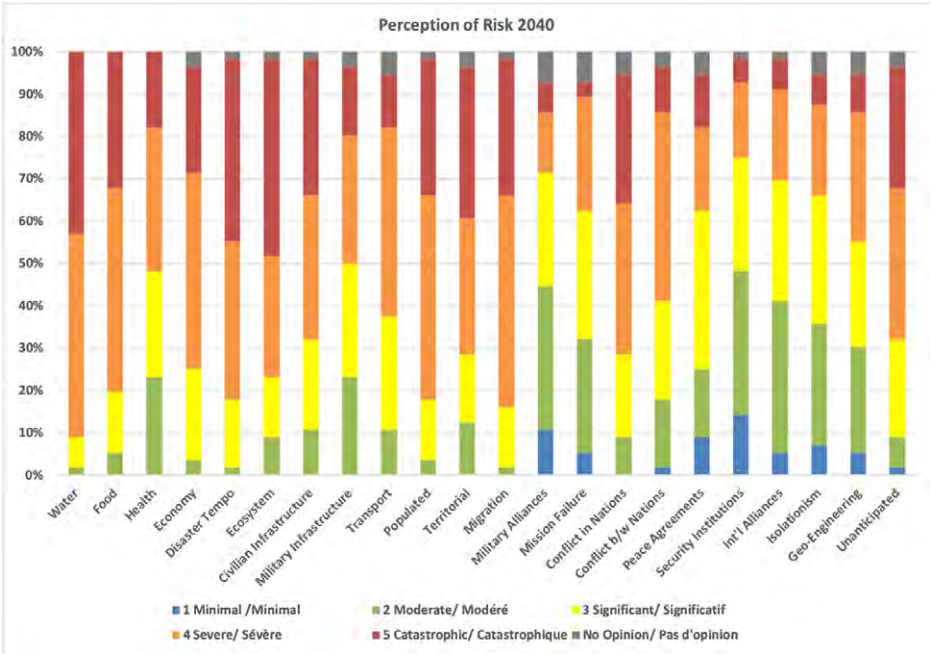


FIGURE 6



5. Respondents generally perceived that the effects of climate change on "security institutions" were lower than other categories of climate security phenomena, but still significant in 2040. Across all three time periods (2020, 2030, and 2040) climate change effects on "security institutions" – including effects on international peace agreements, the rise of isolationism driving nations to withdraw from regional and international security institutions, international political and military alliances, and military missions - were deemed lower than effects to the "security environment" and effects on "security infrastructure," but still significant at the 2040 timescale. While these climate security phenomena were generally perceived to be less of a risk than the security environment and security infrastructure risks, they were not without real concern (see Figure 3 above for reference). For example:

PEACE AGREEMENTS: 70% of respondents identified climate change-exacerbated stresses to existing peace and security agreements and treaties as a significant or higher risk to global security by 2040. 32% of respondents identified stresses to peace agreements due to climate change as potentially severe or catastrophic by 2040.

ISOLATIONISM: 59% of respondents chose increased isolationism at the regional and international scale due to climate change-exacerbated disruptions as a significant or higher risk to global security by 2040. 29% chose increased isolationism due to climate change as severe or catastrophic by 2040.

INT'L ALLIANCES: 57% of respondents identified shifts in alliances and balance of power due to climate change disruptions as a significant or higher risk to global security by 2040. 29% of respondents identified these shifts as severe or catastrophic by 2040.

SECURITY INSTITUTIONS: 50% of respondents identified climate change-exacerbated erosion of key security institutions as a significant or higher risk to global security by 2040. 23% of respondents identified stresses to key security institutions as severe or catastrophic by 2040.

MILITARY ALLIANCES: 48% of respondents identified climate change change-exacerbated degradation of capabilities of key military alliances as a "significant" or higher risk to global security by 2040. 21% of respondents identified stresses to military alliances as severe or catastrophic by 2040.

MISSION FAILURES: 48% of respondents chose military mission failures due to cascading climate-exacerbated threats and disasters as significant or higher risks to global security by 2040. 18% of respondents identified military mission failures as severe or catastrophic by 2040.

The two "security environment" risks that ranked lower than the others were: "Climate change-driven decrease in health security contributing to mass death" and "Unilateral geo-engineering actions intended to reverse climate change" Despite that, the results for 2040 showed significant concern.

HEALTH: 77% of respondents identified climate change-driven decrease in health security contributing to mass death as a significant or higher risk to global security by 2040. 52% identified impacts on health security as severe or catastrophic risks by 2040.

GEO-ENGINEERING: 64% of respondents identified unilateral geo-engineering actions intended to reverse climate change as a significant or higher risk to global security by 2040. 39% identified geoengineering as severe or catastrophic risks by 2040.

There were major changes in the perceptions of these risks across the different timescales, with 0% of respondents choosing severe or catastrophic for geo-engineering in 2020 and 39% doing so in 2040, and 2% choosing severe or catastrophic for health in 2020, and 52% doing so in 2040. None of the climate security phenomena were free from the perception of presenting severe or catastrophic risks between 2020 and 2040.

6. Across the 2020-2040 timescale, the top four perceived risks to global security were consistent: Combining the risk scores of each climate security phenomena by year shows which factors the respondents found overall, across timescales, to be of greatest concern (see Table 2 and 3). These are climate security phenomena that respondents were most concerned about in the near term (a year from 2020), as well as for the medium and long term (2030 and 2040). The top 4 climate security phenomena presenting the greatest overall risks to global security, as perceived by the respondents, are below (see Figure 7 for the full ranking):

CLIMATE CHANGE-DRIVEN CRITICAL ECOSYSTEM LOSS: Risk of rapid changes to the climate driving mass biodiversity loss and extinction, and contributing to critical ecosystem loss that undermines food, water and land systems that are essential for human security

INCREASED TEMPO AND SCALE OF NATURAL DISASTERS DUE TO CLIMATE CHANGE: Risk of increase in tempo and scale of natural disasters, including simultaneous disasters or disasters in rapid succession, that significantly strain response capacity and increase the likelihood of social and political unrest

CLIMATE CHANGE-DRIVEN DECREASE IN WATER SECURITY: Risk of sea level rise, droughts, flooding and rainfall variability driving decreases in the availability of freshwater, and contributing to social and political unrest

INCREASE IN FORCED DISPLACEMENT OR INVOLUNTARY MIGRATION EXACERBATED BY CLIMATE CHANGE: Risk of increase in the forced displacement or involuntary migration of peoples both within nations and internationally, exacerbated by increases in the severity and frequency of extreme weather events.

FIGURE 7

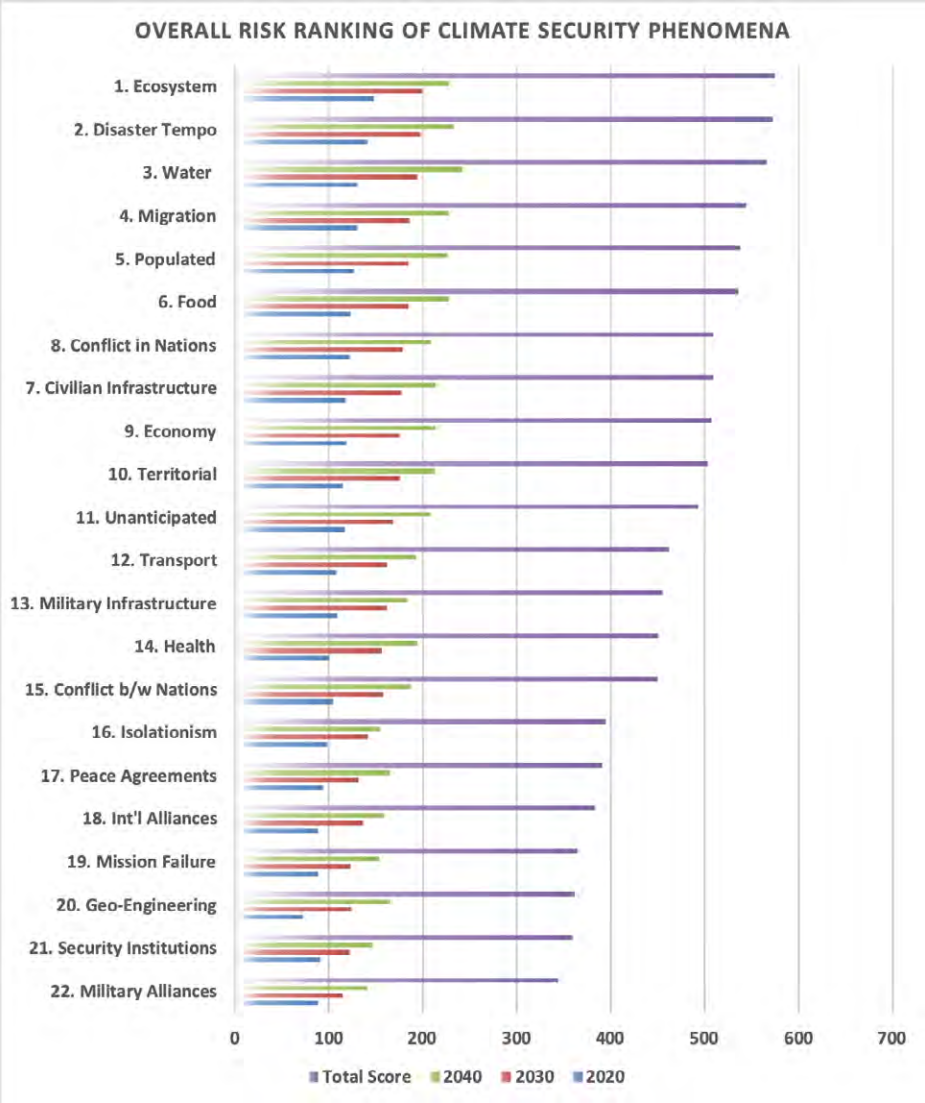

OVERALL RISK RANKING OF CLIMATE SECURITY PHENOMENA
1. Ecosystem
2. Disaster Tempo
3. Water
4. Migration
5. Populated
6. Food
8. Conflict in Nations
7. Civilian Infrastructure
9. Economy
10. Territorial
11. Unanticipated
12. Transport
13. Military Infrastructure
14. Health
15. Conflict b/w Nations
16. Isolationism
17. Peace Agreements
18. Int'l Alliances
19. Mission Failure
20. Geo-Engineering
21. Security Institutions
22. Military Alliances
0
100
200
300
400
500
600
700
Total Score
2040
2030
2020

TABLE 2

RANKING OF CLIMATE SECURITY EFFECTS BY YEAR (1-GREATEST, 22-LEAST)		
RISKS 2020	**RISKS 2030**	**RISKS 2040**
1. ECOSYSTEM	*1. ECOSYSTEM*	*1. WATER*
2. DISASTER TEMPO	*2. DISASTER TEMPO*	*2. DISASTER TEMPO*
3. WATER	*3. WATER*	*3. ECOSYSTEM*
4. MIGRATION	*4. MIGRATION*	*4. MIGRATION*
5. POPULATED	*5. POPULATED*	*5. FOOD*
6. FOOD	*6. FOOD*	*6. POPULATED*
7. CONFLICT IN NATIONS	*7. CONFLICT IN NATIONS*	*7. CIVILIAN INFRASTRUCTURE*
8. ECONOMY	*8. CIVILIAN INFRASTRUCTURE*	*8. ECONOMY*
9. CIVILIAN INFRASTRUCTURE	*9. ECONOMY*	*9. TERRITORIAL*
10. UNANTICIPATED	*10. TERRITORIAL*	*10. CONFLICT IN NATIONS*
11. TERRITORIAL	*11. UNANTICIPATED*	*11. UNANTICIPATED*
12. MILITARY INFRASTRUCTURE	*12. MILITARY INFRASTRUCTURE*	*12. HEALTH*
13. TRANSPORT	*13. TRANSPORT*	*13. TRANSPORT*
14. CONFLICT B/W NATIONS	*14. CONFLICT B/W NATIONS*	*14. CONFLICT B/W NATIONS*
15. HEALTH	*15. HEALTH*	*15. MILITARY INFRASTRUCTURE*
16. ISOLATIONISM	*16. ISOLATIONISM*	*16. GEO-ENGINEERING*
17. PEACE AGREEMENTS	*17. INT'L ALLIANCES*	*17. PEACE AGREEMENTS*
18. SECURITY INSTITUTIONS	*18. PEACE AGREEMENTS*	*18. INT'L ALLIANCES*
19. MILITARY ALLIANCES	*19. GEO-ENGINEERING*	*19. ISOLATIONISM*
20. MISSION FAILURE	*20. MISSION FAILURE*	*20. MISSION FAILURE*
21. INT'L ALLIANCES	*21. SECURITY INSTITUTIONS*	*21. SECURITY INSTITUTIONS*
22. GEO-ENGINEERING	*22. MILITARY ALLIANCES*	*22. MILITARY ALLIANCES*

TABLE 3

RANKING OF LEVEL OF CHANGE ACROSS DIFFERENT TIMESCALES (1-GREATEST, 22-LEAST)		
CHANGE 2020 - 2030 YEARS	**CHANGE 2030 - 2040 YEARS**	**CHANGE 2020 - 2040 YEARS**
1. WATER	1. WATER	1. WATER
2. FOOD	2. FOOD	2. FOOD
3. TERRITORIAL	3. MIGRATION	3. POPULATED
4. CIVILIAN INFRASTRUCTURE	4. GEO-ENGINEERING	4. MIGRATION
5. POPULATED	5. POPULATED	5. TERRITORIAL
6. DISASTER TEMPO	6. UNANTICIPATED	6. CIVILIAN INFRASTRUCTURE
7. CONFLICT IN NATIONS	7. ECONOMY	7. ECONOMY
8. HEALTH	8. TERRITORIAL	8. GEO-ENGINEERING
9. MIGRATION	9. CIVILIAN INFRASTRUCTURE	9. HEALTH
10. ECONOMY	10. HEALTH	10. DISASTER TEMPO
11. TRANSPORT	11. DISASTER TEMPO	11. UNANTICIPATED
12. CONFLICT B/W NATIONS	12. PEACE AGREEMENTS	12. CONFLICT IN NATIONS
13. MILITARY INFRASTRUCTURE	13. MISSION FAILURE	13. TRANSPORT
14. GEO-ENGINEERING	14. TRANSPORT	14. CONFLICT B/W NATIONS
15. ECOSYSTEM	15. CONFLICT B/W NATIONS	15. ECOSYSTEM
16. UNANTICIPATED	16. CONFLICT IN NATIONS	16. MILITARY INFRASTRUCTURE
17. INT'L ALLIANCES	17. ECOSYSTEM	17. PEACE AGREEMENTS
18. ISOLATIONISM	18. MILITARY ALLIANCES	18. INT'L ALLIANCES
19. PEACE AGREEMENTS	19. SECURITY INSTITUTIONS	19. MISSION FAILURE
20. MISSION FAILURE	20. INT'L ALLIANCES	20. ISOLATIONISM
21. SECURITY INSTITUTIONS	21. MILITARY INFRASTRUCTURE	21. SECURITY INSTITUTIONS
22. MILITARY ALLIANCES	22. ISOLATIONISM	*22. MILITARY ALLIANCES*

CONCLUSION

The security risk landscape is complex and dynamic and difficult to easily categorize and contain in charts and figures. However, these survey results present a hopefully useful snapshot of how security and military professionals with experience and expertise on these questions perceive the impact of climate change on that complex system, and on global security.

These survey results present a clear warning about a future security environment with insufficient mitigating actions. The perception of the security and military analysts and practitioners who took the survey is that climate security phenomena will increasingly have more severe and potentially catastrophic consequences on the global security environment over the next 20 years. The worst of the risks will be on the security environment, but over time, civilian and military infrastructure will be more significantly impacted, and regional and international security institutions and alliances will begin to fray. 2040 is only twenty years away, and yet 20 out of the 22 climate security phenomena identified in this analysis were deemed significant or higher risks to global security in that timeframe.

The perceptions of security and military analysts and practitioners matter in terms of shaping security policy, climate policy, and other policies in the future. If these perceptions reflect the reality of the changing security environment, as mounting evidence suggests they do, preparatory, preventive and urgent action is essential.

APPENDIX

A. METHODOLOGY

The survey questions were developed through a literature analysis, followed by a peer-review process with members of the IMCCS Expert Group. The climate security phenomena and categories presented to the respondents in the 22 questions were drawn from a broad range of sources in the climate and security literature, including intelligence assessments, analyses and scenario exercises produced by governments and nongovernmental organizations, and the large body of climate and security research published in academia – on topics including climate change effects on food and water security, state fragility, conflict, infrastructure, defense and geopolitics. For a comprehensive list of sources utilized for the development of the survey questions, see the Center for Climate and Security's Resource Hub.[1]

The survey was administered electronically to a select group of security and military experts and practitioners from across the globe via an online survey. In total, there were 56 respondents from 13 different countries and regions including from Asia, Africa, Europe, the Middle East, and North America. The survey was administered in both English and French.

The ranking of the climate security phenomena was calculated by weighting the responses. This was achieved through multiplying each of the risk score (1 Minimal; 2 Moderate; 3 Significant; 4 Severe; 5 Catastrophic) by the number of respondents choosing that score, and adding the sum of the responses for that climate security phenomena for the year in question. The sums for 2020, 2030 and 240 were then added for each climate security phenomena to reach a score. The highest scores were judged to be the climate security phenomena of greatest concern to respondents (in terms of their level of risk to global security). The ranking of level of change across different timescales was calculated by subtracting the total weighted sum from one year to the next (e.g. Water weighted sum total for 2030 – Water weighted sum total for 2020 = change in water risk perception from 2020-2030).

B. RAW DATA: SURVEY RESPONSE PERCENTAGES

2020 Risk Perception	1 Minimal / Minimal	2 Moderate/ Modéré	3 Significant/ Significatif	4 Severe/ Sévère	5 Catastrophic / Catastrophique	No Opinion/ Pas d'opinion
Water	10.71%	57.14%	21.43%	10.71%	0.00%	0.00%
Food	21.43%	44.64%	26.79%	7.14%	0.00%	0.00%
Health	41.07%	41.07%	16.07%	1.79%	0.00%	0.00%
Economy	17.86%	53.57%	26.79%	1.79%	0.00%	0.00%
Disaster Tempo	7.14%	50.00%	28.57%	12.50%	1.79%	0.00%
Ecosystem	17.86%	28.57%	30.36%	17.86%	5.36%	0.00%
Civilian Infrastructure	19.64%	51.79%	26.79%	1.79%	0.00%	0.00%
Military Infrastructure	32.14%	42.86%	23.21%	1.79%	0.00%	0.00%
Transport	23.21%	55.36%	12.50%	5.36%	0.00%	3.57%
Populated	16.07%	50.00%	25.00%	8.93%	0.00%	0.00%
Territorial	32.14%	42.86%	16.07%	5.36%	3.57%	0.00%
Migration	12.50%	48.21%	35.71%	1.79%	1.79%	0.00%
Military Alliances	46.43%	30.36%	14.29%	1.79%	0.00%	7.14%
Mission Failure	44.64%	35.71%	8.93%	3.57%	0.00%	7.14%
Conflict in Nations	16.07%	55.36%	23.21%	5.36%	0.00%	0.00%
Conflict b/w Nations	33.93%	50.00%	12.50%	3.57%	0.00%	0.00%
Peace Agreements	39.29%	44.64%	10.71%	1.79%	0.00%	3.57%
Security Institutions	53.57%	33.93%	8.93%	3.57%	0.00%	0.00%
Int'l Alliances	53.57%	39.29%	5.36%	0.00%	1.79%	0.00%
Isolationism	44.64%	37.50%	16.07%	1.79%	0.00%	0.00%
Geo-Engineering	66.07%	28.57%	1.79%	0.00%	0.00%	3.57%
Unanticipated	30.36%	33.93%	26.79%	5.36%	1.79%	1.79%

2030 Risk Perception	1 Minimal / Minimal	2 Moderate/ Modéré	3 Significant/ Significatif	4 Severe/ Sévère	5 Catastroph-ic / Cata-strophique	No Opinion/ Pas d'opinion
Water	0.00%	7.14%	48.21%	35.71%	8.93%	0.00%
Food	1.79%	16.07%	41.07%	32.14%	8.93%	0.00%
Health	7.14%	33.93%	32.14%	25.00%	1.79%	0.00%
Economy	1.79%	16.07%	44.64%	33.93%	1.79%	1.79%
Disaster Tempo	0.00%	12.50%	37.50%	33.93%	16.07%	0.00%
Ecosystem	3.57%	12.50%	30.36%	32.14%	21.43%	0.00%
Civilian Infrastructure	3.57%	19.64%	39.29%	32.14%	5.36%	0.00%
Military Infrastructure	1.79%	32.14%	35.71%	26.79%	1.79%	1.79%
Transport	7.14%	12.50%	53.57%	19.64%	3.57%	3.57%
Populated	1.79%	14.29%	42.86%	33.93%	7.14%	0.00%
Territorial	7.14%	19.64%	37.50%	25.00%	10.71%	0.00%
Migration	1.79%	14.29%	41.07%	35.71%	7.14%	0.00%
Military Alliances	17.86%	46.43%	21.43%	5.36%	1.79%	7.14%
Mission Failure	16.07%	35.71%	32.14%	8.93%	0.00%	7.14%
Conflict in Nations	1.79%	17.86%	44.64%	30.36%	5.36%	0.00%
Conflict b/w Nations	7.14%	26.79%	42.86%	23.21%	0.00%	0.00%
Peace Agreements	12.50%	46.43%	23.21%	10.71%	3.57%	3.57%
Security Institutions	25.00%	42.86%	25.00%	3.57%	3.57%	0.00%
Int'l Alliances	19.64%	33.93%	32.14%	12.50%	1.79%	0.00%
Isolationism	16.07%	32.14%	35.71%	14.29%	1.79%	0.00%
Geo-Engineering	17.86%	37.50%	37.50%	1.79%	1.79%	3.57%
Unanticipated	1.79%	25.00%	33.93%	32.14%	3.57%	3.57%

2040 Risk Perception	1 Minimal / Minimal	2 Moderate/ Modéré	3 Significant/ Significatif	4 Severe/ Sévère	5 Catastrophic / Catastrophique	No Opinion/ Pas d'opinion
Water	0.00%	1.79%	7.14%	48.21%	42.86%	0.00%
Food	0.00%	5.36%	14.29%	48.21%	32.14%	0.00%
Health	0.00%	23.21%	25.00%	33.93%	17.86%	0.00%
Economy	0.00%	3.57%	21.43%	46.43%	25.00%	3.57%
Disaster Tempo	0.00%	1.79%	16.07%	37.50%	42.86%	1.79%
Ecosystem	0.00%	8.93%	14.29%	28.57%	46.43%	1.79%
Civilian Infrastructure	0.00%	10.71%	21.43%	33.93%	32.14%	1.79%
Military Infrastructure	0.00%	23.21%	26.79%	30.36%	16.07%	3.57%
Transport	0.00%	10.71%	26.79%	44.64%	12.50%	5.36%
Populated	0.00%	3.57%	14.29%	48.21%	32.14%	1.79%
Territorial	0.00%	12.50%	16.07%	32.14%	35.71%	3.57%
Migration	0.00%	1.79%	14.29%	50.00%	32.14%	1.79%
Military Alliances	10.71%	33.93%	26.79%	14.29%	7.14%	7.14%
Mission Failure	5.36%	26.79%	30.36%	26.79%	3.57%	7.14%
Conflict in Nations	0.00%	8.93%	19.64%	35.71%	30.36%	5.36%
Conflict b/w Nations	1.79%	16.07%	23.21%	44.64%	10.71%	3.57%
Peace Agreements	8.93%	16.07%	37.50%	19.64%	12.50%	5.36%
Security Institutions	14.29%	33.93%	26.79%	17.86%	5.36%	1.79%
Int'l Alliances	5.36%	35.71%	28.57%	21.43%	7.14%	1.79%
Isolationism	7.14%	28.57%	30.36%	21.43%	7.14%	5.36%
Geo-Engineering	5.36%	25.00%	25.00%	30.36%	8.93%	5.36%
Unanticipated	1.79%	7.14%	23.21%	35.71%	28.57%	3.57%

1 See the Center for Climate and Security's Resource Hub: https://climateandsecurity.org/resources/

OPPORTUNITIES

III. CLIMATE SECURITY GAME RESULTS

This chapter includes the results of climate and security game administered by *the Hague* Centre for Strategic Studies, and includes detailed descriptions of the results of three previous "Climate Security Capability Games," and lessons from those games for policy-makers.

ANALYSIS BY:

Michel Rademaker
Co-Founder and Deputy Director
The Hague Centre for Strategic Studies

INTRODUCTION

Building on the comprehensive assessment of the security risks of climate change from the "Global and Regional Risks Overview," and the results of the "Climate Security Risks Perception Survey," it is instructive to explore and test possible capabilities needed to address those security risks. The Climate Security Strategic Capability Game is a tool that supports both requirements and is designed with the aim of increasing awareness about relevant capabilities and capacities that are needed for conflict prevention in the context of climate change; to address what climate change will mean for the planning of policies, activities and operations of different departments or ministries; and to discuss the role of militaries in climate change prevention, response and reconstruction.[1]

The game design recognizes that although environmental factors are never the sole cause of violent conflict, climate change can be seen as a "threat multiplier" that exacerbates environmental challenges and natural resource scarcity, and contributes to the onset of violence both within and between states.[2] As the report findings highlight, water and food scarcity, exacerbated by droughts, floods, sea-level rise and extreme weather events, can further erode economic and social conditions in already fragile areas. Where institutions and governance are lacking, affected populations might choose to migrate in search of usable land and water, or flee into the hands of terrorist or extremist organizations. In this way, climate risks multiply other threats we already face.[3]

In this chapter we explain how the game works and relevant terminology, and we provide a reconstruction and debrief of the results of multiple rounds of the game that has been played by organizations around the world from Europe to Africa. On the basis of these results we provide some first insights and recommendations.

WHAT IS THIS GAME ABOUT?

The Climate & Security Strategic Capability Game is a board game, based on a serious gaming methodology that relies on a generic analytical framework[4] developed by HCSS. HCSS tailored the game, with support from the Clingendael Institute for the purpose of climate security strategic capability analysis. The game helps structure strategic discussions around real-world challenges, and introduces game participants to strategic capability thinking. Serious gaming has proven particularly useful in generating policy-relevant insights[5] and it facilitates strategic discussions on what organizations are and/or are not capable of; makes it possible to assess existing capabilities and to identify capabilities that are lacking; and it also supports the transfer of knowledge on capability building, as well as network development. In addition to helping identify promising new capabilities, exercises using this serious gaming methodology help raise awareness and understanding of issues at stake.

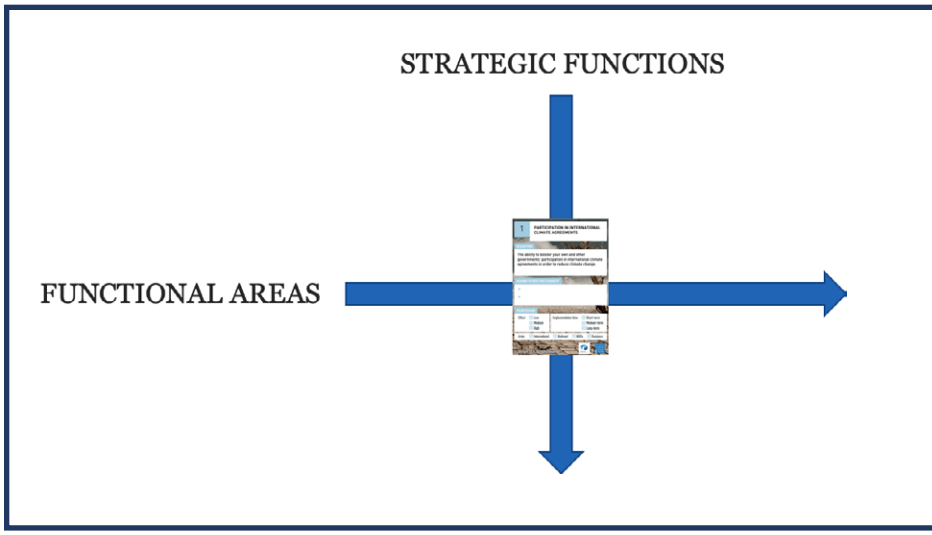
The picture above shows the board game that could be seen as an excel sheet with columns and rows. The columns represent strategic functions and the rows functional areas.

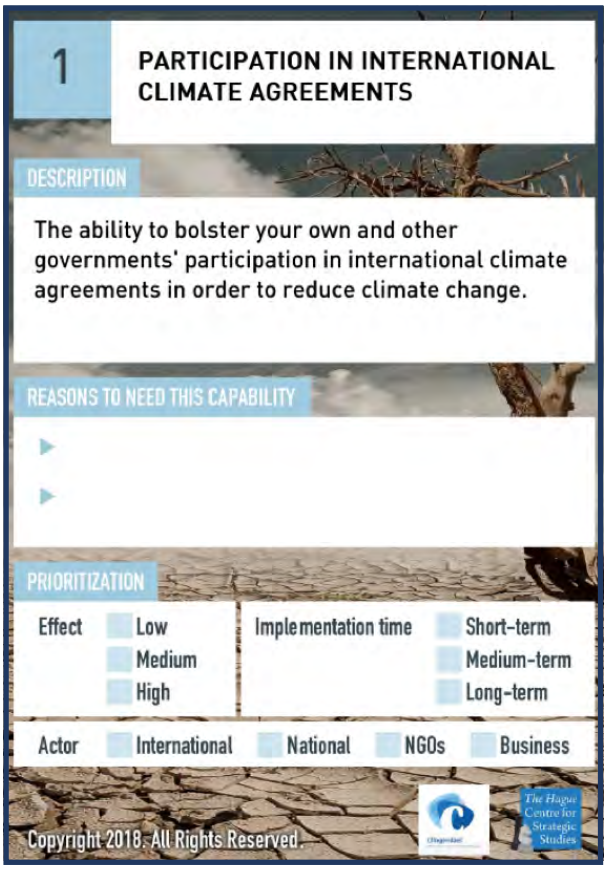
When combining the two in an analytical framework (the game board) one can imagine that a combination of a strategic function with a functional area raises the question "what capability do I need to execute this strategic function?"[6]

WHAT ARE THESE CAPABILITIES?

The capabilities that are available to be played are listed on playing cards. Players can put a card on the board where a row and a column intersect as shown in the figure above. The syntax of each capability description is formulated as 'the ability to … [do something] … with [an intended effect]". See the Appendix on page 131 for a full list of Capability Card descriptions.

Capabilities are applicable to a variety of different strategic functions.





On each card executed a player can choose to activate that capability for a particular set of actors, what the most probable implementation time is for that capability as well as the foreseen effect.

Actor level: Development and implementation of selected capabilities can fall under the responsibility of international actors, national actors, NGOs and/or businesses.

Implementation time: Implementation of climate & security capabilities requires time and planning. The period of time needed to implement a given capability can be short-term, medium-term or long-term.

Intended effect: Selected capabilities can have low, medium or high effect.

Empty cards are available for participants to introduce new capabilities too!

WHAT ARE THE STRATEGIC FUNCTIONS?

The strategic functions are the basic purposes for which the organization(s) or the "system" as a whole will focus their most important efforts. If these functions are not executed well the effects will be suboptimal.

PREPARE: Capabilities aimed at enhancing resilience, planning and preparing for the consequences of climate change by, for example, enhancing flood defenses, improving irrigation techniques and early warning systems, etc.

RESPOND: Capabilities aimed at limiting the direct impacts of a changing environment, natural disasters related to climate change, as well as the magnitude of long-term climate change.

AFTER-CARE: Capabilities aimed at establishing long-term solutions to climate change impacts, and supporting the recovery process of disaster-affected communities.

WHAT ARE THESE FUNCTIONAL AREAS?

The functional areas were selected using the DIME approach, which categorises potential impacts into Diplomatic, Informational, Military and Economic domains.

DIPLOMATIC: Capabilities encompassing international relations, diplomacy, dialogue and negotiations, including the creation of international treaties, policies and law.

INFORMATIONAL: Capabilities encompassing the dissemination and collection of information and education in the broad sense of the word, facilitating learning processes and the gathering of knowledge, skills or habits.

MILITARY: Capabilities possessed by (personnel working for) the armed forces and national defense agencies.

ECONOMIC: Capabilities in the realm of economics such as trade policies, tariffs, subsidies, capital and infrastructure investments, and (financial) assistance.

SCENARIOS

The strategic capability game does not focus on just a single possible scenario. "Strategic" in this case means that each selected capability would ideally be useful in as many future scenarios as possible. This means that investments in the development, upkeep and or further strengthening of a capability most likely would be beneficial for a multitude of possible future scenarios.

To help the players in this regard we developed a set of five very different scenarios that represent a spectrum of possible climate security situations where capabilities might be required. These scenarios or problems were then used as background information for the players to refer to when thinking of the required capabilities.

DELTAS UNDER PRESSURE IN AFRICA

Climate change impact: *Sea-level rise and decreasing water flows of the central river system dramatically reduce water quality in the delta where the capital is home for 15 million people*

Direct consequences: *salt water intrusion lowers water quality of the coastal aquifers; land degradation (salinity and pollution) is predicted to reduce agricultural productivity by 50% over the next five years*

Indirect consequences: *A 20% increase in food prices leads to social tensions and violent riots in the capital – more than 200,000 people protest against cuts of irrigation subsidies; in addition, the security situation deteriorates in some parts of the city*

Challenges: *water supplies, agriculture, land degradation*

International Security: *Riots in the capital might destabilize the whole country and spill over into neighboring states facing similar climate change impacts – potentially destabilizing a whole region*

HEAT IN A CITY IN SOUTHERN EUROPE

Climate change impact: *Sea-level rise and decreasing water flows of the central river system dramatically reduce water quality in the delta where the capital is home for 15 million people*

Direct consequences: *salt water intrusion lowers water quality of the coastal aquifers; land degradation (salinity and pollution) is predicted to reduce agricultural productivity by 50% over the next five years*

Indirect consequences: *A 20% increase in food prices leads to social tensions and violent riots in the capital – more than 200,000 people protest against cuts of irrigation subsidies; in addition, the security situation deteriorates in some parts of the city*

Challenges: *water supplies, agriculture, land degradation*

International Security: *Riots in the capital might destabilize the whole country and spill over into neighboring states facing similar climate change impacts – potentially destabilizing a whole region.*

LONG-TERM DROUGHT IN THE MIDDLE EAST

Climate change impact: *After two seasons without rainfall, predictions are for another dry year for the country, particularly hitting the Eastern regions*

Direct consequences: *Water availability in the East decreases by more than 75%, minimal supplies rely on one aquifer and one wastewater treatment plant. Food production in the country's main agricultural center ceases, reducing national food production by 65%*

Indirect consequences: *Severe water and food shortages countrywide; 20% of the population is affected by malnutrition (and partly under-nutrition). In the Eastern regions more than 3 million working in agriculture and related sectors are unemployed of which 600,000 have left the region and started to live in informal settlements on the outskirts of the capital. Tensions over water and food and violent conflicts between sectors and communities become more prevalent; protests against the government are organized countrywide.*

Challenges: *food shortages, economic conditions/livelihoods, internal and regional migration*
International Security: Legal and illegal migration into neighboring countries leads to violent clashes in the hosting communities; neighboring states close their borders.

FIRST SMALL ISLAND DEVELOPING STATES (SIDS) DISAPPEAR

Climate change impact: *Sea-level rise reaches the "critical 60 cm scenario" faster than expected*

Direct consequences: *After the "end of the nation" could be delayed for ten years, the government requests every citizen still on the island to leave within ten weeks since the upcoming hurricane season is predicted to drown the first of the SIDS for good*

Indirect consequences: *(for other countries) 25,000 on the island expected to immigrate other countries*
Challenges: Safety issues, legal status of the citizens, mechanisms for the resettlements
International Security: Status of the abandoned islands and the migrants not clear.

WARMING ARCTIC

Climate change impact: *Greater temperature increase compared to the global average intensifies the climate change impact and accelerates the melting of the sea ice*

Direct consequences: *Sea ice extent is predicted to decrease by 30-40% in the next 10 years, some of the glaciers will permanently disappear*

Indirect consequences: *Forests will expand northwards, but carbon dioxide uptake is overwhelmed by effects of thawing tundra regions, complete loss of summer sea-ice polar species. Warming may improve certain fish stocks as cod and herring but threaten others as northern shrimp; indigenous population suffers from food shortages since vegetation shifted and many species disappeared. Northern Sea Route navigation season increases from 20-30 days per year to 120 within the next 40 years. Easier access of fossil fuel resources leads to disputes over ownership, the extraction increases pollution in the region*

Challenges: *Various "new" legal and security issues, international cooperation increases in the field of navigation and shipping*

International Security: *Military confrontation in the region between global/great powers.*

GAME PLAY

The game play unfolds in two stages. In the first stage, participants discuss and analyze existing Climate & Security capabilities. They are first invited to familiarize themselves with a list of 46 proposed capabilities represented on the cards clustered into the DIME functional areas and then to evaluate and explain their application and relevance (or lack thereof) across different scenarios. Although consensus among all players is not required when playing the game, justification and explanation of the choice of a capability card, and of its placement on the game board, are required.

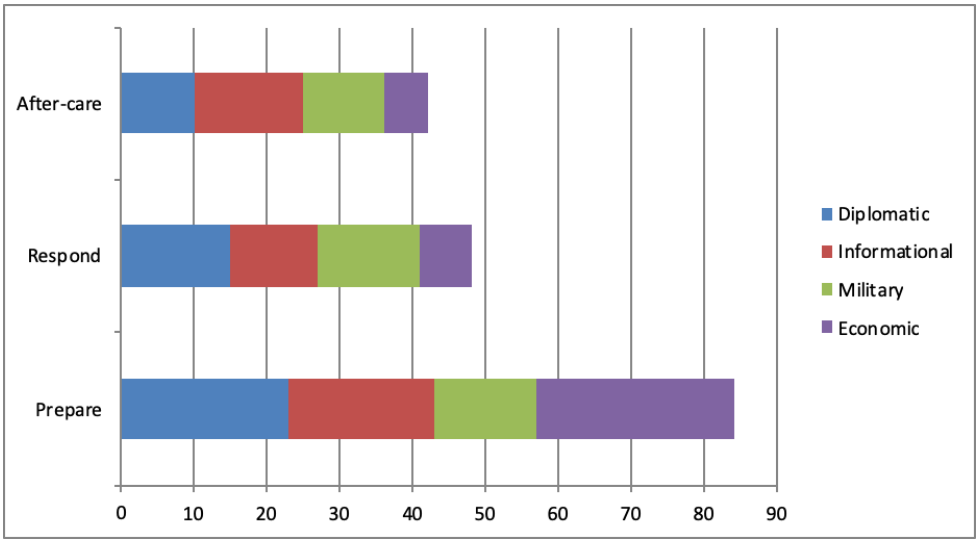
Every time the game is executed we put the players in an independent position. They are not role players. This means in practice that we ask them to execute the game in a purely rational manner and to avoid introducing wishful thinking or biased preferences for certain approaches.

All the results are captured by analysts during the game play and incorporated into an after action analysis.

RESULTS

In the period between October 2018 and October 2019 multiple games were executed under Chatham House rule, with over 100 total participants. Participants varied from civil servants of Dutch departments of Defence and Foreign Affairs, politicians of the Netherlands Second and First Chamber, international participants from across the globe during the Planetary Security Initiative conference in February 2019, as well as participants of an international course related to the ongoing Water Peace Security project, and a team of officials from Mali. With the participants from the course and the team of Mali officials, the focus of the game was on Mali and to a slightly lesser degree on water and security. During the course while executing the game we asked the players to first be objective and rational and disregard any role they (in practice) might represent. In the second round of that game we asked them to take up a specific role like representing a ministry, NGO or other actor. This gave the analysis another extra dimension too.

The results of these executed games were summarized and analyzed. We have not presented any individual scores here from any single game in to guard against any sensitivity in disclosing results.



During the game, players observed and became aware of the broad spectrum of capabilities that are required to create more resilience and mitigate climate-induced insecurity and realized that a multidisciplinary approach is required. Most capabilities were assessed to be required in the strategic functions "prepare" and "respond"; fewer capabilities were identified as being required in the "aftercare" function.

Most participants concluded that they did not oversee all required and/or possible capabilities upfront and concluded that it enriched their insight and understanding. Participants considered the understanding of the different national approaches as particularly valuable. In this regard, the game was considered useful in helping participants structure their thoughts, and decide which capability developments should be prioritized.

In the diplomatic functional area, capabilities such as participation in international climate agreements, disaster diplomacy, governance of sea lanes and resources, and coordination of emergency incidents and

disasters were concluded to be of strategic importance. The ability to engage in disaster diplomacy in order to coordinate emergency relief among international actors stood out as the most important capability in this functional area. Players underlined the need to prevent potential future crises. Participation in international agreements, therefore, was considered to be vital as well as the involvement of and cooperation among a wide range of actors. They also concluded that participation in international agreements needs both positive and negative incentive structures for participation and compliance.

In the informational functional area, climate change requires a bottom-up approach, which begins at the local level. The ability to provide and teach information on climate change in native languages would enhance such bottom-up comprehension and adaptation. The Lake Chad Basin was used as an example where translating information into local languages would have a profound impact. Local expertise can be encouraged by having local experts contribute to the rebuilding and strengthening of their communities after disasters, vulnerable regions could become more resilient and self-reliant. Additionally, the importance of locally tailored information campaigns as a distinct tool for educating communities on climate matters was emphasized as were improved adaptation processes, increased public support, and efficient mobilization of local resources and knowledge.

In the military functional area, the ability of the military to reduce their carbon footprint in an operational environment was addressed. Ensuring the security and safety of military operations in risk areas was considered essential and requires the capability of integrating climate-related intelligence and deployment planning into military missions. There was a general agreement among game participants that cooperation between civilian and military actors is a crucial, if not the most important, capability in emergency situations. The ability to successfully relocate internally displaced persons (IDPs) and establish camps with sufficient resources in the direct aftermath of natural disasters was discussed across all five tables and seen as a responsibility of the military.

In the economic functional area, improvement of critical infrastructure in risk areas was considered important across all players. Participants considered this capability to be directly related to urban resilience. It was noted that understanding and improving the ability of cities to manage and avoid the negative effects of climate related changes and events is of utmost importance. Participants agreed that economic policy instruments, in general, can spur behavioral change. The ability to motivate people and businesses to change their behavior can provide a crosscutting solution to many other problems.

Across the board, public support stood out as crucial for the implementation of climate security capabilities. Because of the trust the public places in the military, particularly in Western Europe and the United States, experts from the military and security communities can build credibility in climate action and sustainable development and, as such, enhance citizen support for climate policies. In addition to advocacy, the military and security sector play an important role in risk analysis, responding to natural disasters, and reducing their own environmental impact. Improved cooperation between diplomacy, development, and hard security professionals was also brought forward as essential for effectively addressing climate-related security risks. As climate change is a global collective action problem, all relevant actors need to be involved and collaborate in tackling issues at stake. Climate related security risks are complex and require multi-stakeholder, multidimensional, and transboundary solutions. A tailored approach to addressing climate change impacts is needed. The causes and extent of vulnerabilities can vary, so policy makers should be able to tailor their strategies to different countries and regions.

APPENDIX: CAPABILITY CARD DESCRIPTIONS

DIME	TITLE OF CAPABILITY	CAPABILITY DESCRIPTION
D	Participation in international climate agreements	The ability to bolster your own and other governments' participation in international climate agreements in order to reduce climate change.
D	Agreements on transboundary rivers	The ability to successfully negotiate international agreements on allocation and use of major transboundary rivers in order to reduce the risk of transboundary water conflicts.
D	Joint management institutes over transboundary waters	The ability to set up joint management institutes over shared transboundary waters in order to reduce the occurrence of cross-boundary water shortages.
D	Disaster diplomacy	The ability to engage in disaster diplomacy in order to coordinate emergency relief among international actors.
D	International dialogue mechanisms	The ability to develop international dialogue mechanisms for stakeholders with a vested interest in a particular geographical area affected by climate change in order to avoid civil conflict.
D	Climate change mitigation programs	The ability to set up climate change mitigation programs in developing countries in order to enhance resilience of fragile societies to climate change.
D	Cooperation for emissions reduction	The ability to improve legal and institutional systems for emissions reduction (e.g. in the forestry sector) in order to reduce climate change.
D	Flexible climate governance	The ability to design flexible climate governance laws in order to make them more effective in the face of changing local contexts and climate change forecasts.
D	Governance of sea lanes and resources	The ability to establish laws governing newly-opened sea lanes and resources in the Arctic (due to global warming) in order to avoid conflicts or tensions.
D	Inclusive policies	The ability to include vulnerable and marginalized groups in climate change adaptation policies in order to develop more inclusive policies.
D	Coordination of emergency incidents and disasters	The ability to establish mechanisms by which emergency management stakeholder agencies and resources are coordinated in order to ensure that all incident response requirements are met.

I	Local-level adaptation	The ability to translate international climate change scenarios into local-level assessments in order to gain better insight into local climate change impacts.
I	Bottom-up adaptation	The ability to provide and teach information on climate change in native languages and to train local experts in order to enhance bottom-up understanding and adaptation.
I	Distribution of information	The ability to distribute information on the post-disaster situation in order to better manage and coordinate evacuation operations and relief aid.
I	Local healthcare expertise	The ability to improve local healthcare expertise in order to offer better health services (after events).
I	Education and training for alternative livelihoods	The ability to educate and train local populations in order to provide them with new livelihood opportunities, if needed, due to climate change impacts.
I	Local expertise	The ability to train local experts to continue working on rebuilding and strengthening societies after emergency relief workers have left in order to increase their self-reliance.
I	Public support	The ability to increase public support for climate change adaptation measures in order to facilitate successful adaptation policies.
I	Local information campaigns	The ability to translate traditional climate science into tailored information campaigns for (local) policy-makers in order to increase their knowledge and awareness of issues at stake.
I	Public communication	The ability to utilize public communication in order to disseminate warning signals and post-disaster information.
I	Behavioral change	The ability to motivate people and businesses to reduce their climate change-aggravating behaviour in order to reduce climate change.
I	Learning from experience	The ability to learn from natural disaster experiences and make local impact assessments in order to improve international resilience programs and to better tailor aftercare operations.
I	Innovative solutions	The ability to build/develop expertise and innovative solutions in order to rebuild societies in the aftermath of natural disasters or climate change-induced societal problems.
I	Emergency response information	The ability to provide emergency response information in the direct aftermath of natural disasters in order to facilitate relief operations.
I	Emergency response technologies	The ability to equip emergency managers and response personnel with appropriate technology tools (e.g. drones, satellite imagery through GIS, real-time disaster modeling) to better tackle the immediate challenges faced during a natural disaster and to better prepare for future natural disasters.

M	Military CO2-emissions reductions	The ability to cut down CO2 emissions of the military through energy saving and adoption of new sources of energy in order to reduce their carbon footprint in affected areas.
M	Protection of civil relief personnel	The ability to protect civil relief personnel after disasters (in conflict or conflict-prone areas) in order to facilitate a safe work environment.
M	Civil-military cooperation	The ability to execute civil-military cooperation when assisting in rebuilding societies after extreme weather and climate events and/or incorporating climate adaptation measures in peacebuilding missions in order to improve disaster resilience in developing countries.
M	Sustainable military camps	The ability to design and plan military camps in a sustainable way in order for them to serve communities and other purposes after military units have left.
M	Safety of personnel	The ability to ensure the safety of personnel in risk areas in case of extreme weather events, disease outbreaks, or natural disasters in order to prevent human suffering.
M	Emergency command and control (C2)	The ability to exert command and control over an emergency response and recovery operation in order to ensure an effective and consistent response.
M	Relocation of internally displaced persons (IDPs)	The ability to successfully relocate internally displaced persons (on a long-term basis) in order to avoid tension.
M	Emergency relief operations	The ability to set up emergency relief operations after extreme weather events or natural disasters (such as logistics, food provision, emergency reparations and evacuations, medical support, securing displaced persons' camps) in order to reduce their negative impact on local communities.
M	Displaced persons camps	The ability to establish displaced persons camps with sufficient resources (shelter, clean water, food) in order to prevent human suffering and the risk of conflict in the direct aftermath of natural disasters.

E	Critical infrastructure improvement	The ability to improve critical infrastructure in risk areas to decrease their vulnerability to extreme weather events.
E	Infrastructure reparations	The ability to restore and replace (critical) infrastructure after natural disasters in order to facilitate communications and emergency relief operations, as well as to speed up the disaster recovery process.
E	Renewable energy	The ability to develop renewable energy projects in order to adapt to climate change and reduce emissions.
E	Subsidies for livelihood diversification	The ability to set up livelihood diversification and low-impact agriculture projects in order to adapt to changed environmental circumstances.
E	Carbon pricing	The ability to implement carbon pricing mechanisms (such as emissions trading and carbon taxes) in order to shift the burden for damage back to polluters.
E	Mobilisation for disaster response	The ability to mobilize human and financial capital in order to ensure a rapid and adequate response to disasters.
E	Innovation	The ability to drive innovation in the field of climate change adaptation in order to speed up the adaptation process.
E	Corporate Social Responsibility (CSR)	The ability to engage in CSR activities in order to promote funding of sustainable development programs and environmentally friendly business strategies.
E	Food security	The ability to provide emergency food aid, improve storage technologies, and monitor food prices in order to avoid food shortages (and possible food riots) in the event of natural disasters.
E	Urban resilience	The ability to adapt infrastructure (including airports) and urban development planning to the risks of climate change in order to avoid social and political disruption, as well as to handle people and relief goods after disruptive events occur.
D	Punishment for environmental crimes	The ability to hold actors accountable for environmental disasters in order to prevent their recurrence.
I	Psychological support	The ability to provide psychological support to disaster victims in order to reduce human suffering after disasters and to prevent trauma.

NOTES

1 Since its establishment in 2007, HCSS has carried out over 30 serious gaming exercises for Dutch, European, Transatlantic and international groups that yielded numerous policy-relevant insights. The most recent examples include the European Capabilities Assessment Game for the European Defense Agency (2017) and the Strategic Capability games for the directors of Dutch regional security organizations (2018).

2 Amina J. Mohammed (Deputy Secretary-General) on Understanding and Addressing Climate-Related Security Risks - Security Council, 8307th Meeting." 2018. *United Nations Web TV*. June 11, 2018. http://webtv.un.org/watch/amina-j.-mohammed-deputy-secretary-general-on-understanding-and-addressing-climate-related-security-risks-security-council-8307th-meeting/5808008796001/?term=

3 Fairhead, Edward. 2019. "Interview - Sherri Goodman." *E-International Relations* (blog). January 24, 2019. https://www.e-ir.info/2019/01/24/interview-sherri-goodman/.

4 *The Hague* Centre for Strategic Studies has the copyright of the underlying analytical framework and game concept used for the Climate & Security Strategic Capability Game ©. The game concept was tailored for Climate & Security in cooperation with the Clingendael Institute.

5 "Release: International Military Council on Climate and Security Announced at The Hague." *The Center for Climate and Security, the Netherlands Institute of International Relations (Clingendael)/ the Planetary Security Initiative, the French Institute for International and Strategic Affairs (IRIS), the Hague Centre for Strategic Studies.* February 21, 2019. https://climateandsecurity.org/2019/02/19/release-international-military-council-on-climate-and-security-announced-at-the-hague/

6 Strategic capability thinking is based on the understanding of a capability as "the ability [...] to do something [...] with an indented effect".

IV. HIGHLIGHTS: MILITARY BEST PRACTICES ON CLIMATE AND SECURITY

A highlight of best practices on addressing climate and security risks among select national militaries and security establishments, as well as intergovernmental security and military institutions.

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Following this report's extensive overview of the effects of climate change (droughts flooding, etc) and of its current security implications (extremism, migration, internal tensions/conflicts, etc) we now turn to how countries and their armed forces are adapting. Several military organizations around the globe now recognize the security dimension of climate change. Many find themselves increasingly confronted with extreme weather or its impact as a threat multiplier. Military organizations are also relatively big contributors to greenhouse gas emissions due to the equipment they use and the land and buildings they own. Since climate change impacts are expected to accelerate, a review of best practices can be useful in formulating effective responses. At the same time, international organizations, including the UN, NATO and the EU are working on this issue in an attempt to foster cooperation by military organizations in addressing climate change.

For this report, we reviewed the efforts of 12 national militaries: Australia, Canada, Finland, France, Germany, Jordan, the Netherlands, New Zealand, Norway, Sweden, the United Kingdom and the United States. We realize that the countries studied are not a representative sample, but chose them based on indications they have begun considering the implications of climate change for their armed forces. This was based on written sources and their representation in the International Military Council on Climate and Security (IMCCS).

For each of the countries, we interviewed national experts and conducted a review of literature and policy documents. In our interviews we asked the following questions:

1. *RISK ASSESSMENT:* which changes in the climate are considered most important in terms of their having an impact on your country's national security?

2. *SECURITY AND DEFENCE STRATEGY AND POLICY:* is climate change taken into account by your country's Ministry of Defence (and how)?

3. *NATIONAL (SUPPORT) TASKS:* what consequences does climate change have for the armed forces in responding to the effects on national territory (and, when applicable, on overseas territories)?

4. *INTERNATIONAL MILITARY OPERATIONS:* what consequences does climate change have on international operations (types, geographical orientation, etc.)?

5. *PERSONNEL AND EQUIPMENT:* what impact does climate change have on personnel (education and training, clothing, etc.) and equipment?

6. *GREENIFICATION:* what contributions are the armed forces making (or planning to make) to reducing climate change (such as greenhouse emission reduction targets, green infrastructure, sustainable fuel, etc.)?

An overview of the case studies can be found in a related report written for the Netherlands Ministry of Defence. Here we concentrate on key findings with regard to the questions above.

INCLUSION OF CLIMATE CHANGE IN NATIONAL AND INTERNATIONAL RISK ASSESSMENT

The geographical location of a country has a major impact on its risk assessment. For instance, countries with overseas territories have to deal with climate change impacts in various regions of the world. France, the Netherlands and the United Kingdom have major concerns about their overseas territories, in particular in the Caribbean, the Indian Ocean and the Pacific. Sea level rise, storms, hurricanes and forest fires endanger the security of their overseas territories. In particular, inhabitants of small islands in the South Pacific are threatened by lack of food and clean water, by the spread of diseases and reduced fishery resources which might even lead to violence and migration. For some of these islands, sea level rise poses an existential threat since they are being washed away. This threat is also relevant for naval bases on low lying islands, such as the U.S. bases on Guam.

The climate challenges confronting Pacific island nations are also a major concern to Australia and New Zealand as many of these islands are in their sphere of influence. Both countries also consider their own territory endangered by rising sea levels, potentially resulting in coastal erosion, increased soil salinity and a reduction of productive land. Australia also has to deal with the risks emanating from rising temperatures and long periods of drought – e.g. leading to energy black-outs, wildfires, shortage of water and food caused by poor harvests.

The U.S. considers increasing risks to national territory (disasters, in particular flooding and other hurricane effects) and pays considerable attention to the geostrategic impact of ice melting in the Arctic region. The latter also applies to Norway. Canada is facing a multitude of challenges from the Arctic ice melting, including coastal erosion, flooding, impact on food resources, land- and rockslides, etc. Heat waves pose another risk category, in particular with regard to forest fires. Canada also expects an increase of migrant flows from elsewhere in the world due to climate change effects. Finland and Sweden have Arctic security high on their list, but both countries tend to assess the risks of climate change primarily in relation to their national territory and the Baltic Sea area. For both Finland and Sweden, rising sea levels, storms and other weather extremes causing flooding or rock slides (also caused by melting ice and snow) will also impact national security.

France is concerned about the Arctic as well, in addition to climate change effects in the Sahel region such as increased instability and conflicts due to food and water shortages. In France itself, sea level rise, heat waves and drought, heavy rainfall and extreme weather are considered as major risks. The spreading of non-native insects which could bring tropical diseases to metropolitan France, is mentioned as another risk related to climate change. Increased flooding, endangering coastal areas but also inland low-lying areas, is considered a serious risk as well as higher temperatures. The United Kingdom considers sea level rise and heavy rainfall, as well as temperature rise as climate change risks. Germany assesses the risks to its national territory as mainly related to ice melting in the Alps (flooding of the Rhine), storms and sea level rise. Germany also considers serious security risks related to climate change effects elsewhere in the world, in particular in the Arctic and the Middle East/North Africaregions. The same is the case for the Netherlands.

Jordan is mostly affected by the consequences of water shortages, which are considered to be a national security risk which could additionally lead to other effects like refugee flows and large-scale migration. The country is increasingly dependent on international water management arrangements, which are lacking in the Middle East.

SECURITY & DEFENCE STRATEGIES AND POLICIES

The French and British security and defence strategies already identify climate change as a factor impacting the armed forces, in particular in terms of emergency operations, both at home and overseas. The UK underlines the whole-of-government approach to tackle climate change, in a preventive manner and in terms of responses to emergencies and crises. Military planners are seconded to other key government departments. The Ministry of Defence is supported by the Defence Infrastructure Organisation and the Development, Concepts and Doctrine Centre for identifying the consequences and measures for the British defence infrastructure respectively for assessing future trends.

In France, the Directorate General for International Relations and Strategy elaborates the defence climate policy, supported by the research activities of the Observatory on Defence and Climate. France also works closely with partner countries, including Australia and New Zealand in the South Pacific, as well as with several North African states, conducting joint defence studies on climate change impact as well as other activities.

The 2016 White Paper on German Security Policy and the Future of the Bundeswehr refers to climate change as a challenge to security policy. However, the operational implications for the German Armed Forces still need to be integrated into its planning system. The Bundeswehr Office for Defence Planning is addressing these issues, through, among other things, scenario development.

Norway and Sweden have a total defence concept, in which the armed forces are incorporated in civil emergency planning structures under civilian leadership. Until now, climate change has not been incorporated in defence planning documents in those two countries. Most probably, the next edition of the Norwegian Long-Term Defence Plan (2021-2024) will take the impact of climate change on the country's armed forces into consideration, based on a report of the Norwegian Armed Forces Defence Research Institute (FFI) published in February 2019. The Finnish National Defence Strategy refers to the environmental effects of climate change and states that the armed forces must be ready to respond to the threats, if necessary, on their own.

The 2017 Australian Defence White Paper labels climate change as a risk-multiplier, exacerbating other security challenges. In terms of climate impact, the White Paper refers primarily to emergency operations. The Ministry of Defence has published three documents on defence environmental strategy, policy and planning.

New Zealand just released a new Defence strategy in which climate change is prominently included. It builds upon the 2018 New Zealand Defence Assessment and outlines recommendations to advance Defence's work on climate change. Preparing and responding to the intensifying impacts of climate change in both New Zealand and more broadly in the Pacific are central in this new plan. New Zealand's Strategic Defence Policy (2018) also refers to climate change, envisioning a possible increase of operations in the South Pacific and arguing for deepening partnerships with other countries in the region. The 2018 Defence Assessment on Climate Change points to an increased need for emergency operations in the region. A maritime security strategy or policy is under review.

Canada's latest defence policy (2019) mentions climate change as a national security threat, in particular related to the Arctic region. Canada also considers climate change as a threat multiplier in countries with already weak governments and resource scarcity as more instability and potentially conflicts could be created.

The United States was a frontrunner in planning for climate change effects on its armed forces. For example, the 2010 Quadrennial Defence Review recognized climate change as a national security threat. However, current high level security and defence strategies and policies such as the 2017 National Security Strategy do not reference climate change. Nonetheless policy actions at the operational level are addressing climate security impacts already occurring such as the Atlantic Fleet sortieing into open waters from the Norfolk Naval Station every time natural high tides occur, which happens on average 10 times per year. Commanders of military bases are highly concerned about the vulnerability of U.S. military installations, which oftentimes is related to a general lack of infrastructure maintenance and inadequate flood and disaster risk reduction measures.

NATIONAL TASKS (INCLUDING OVERSEAS TERRITORIES)

All twelve countries expect an increase of their armed forces involvement in emergencies domestically or overseas, either acting alone as a first responder or in close cooperation with civil actors. Such civil-military cooperation in response to national disasters is nothing new, but the armed forces might be called upon more often and asked to bring more capacities to bear. Depending on geographic location and the nature of the disaster the most likely military emergency response operations will have to handle forest or wildfires, flooding, rock slides, search and rescue, power outages, etc. (see table X for an overview).

France expects calls on the navy for its constabulary missions (countering illicit trafficking, fishing, pollution, etc.) near overseas territories in the Indian and Pacific Oceans. Australia and New Zealand also expect more involvement of their armed forces in responding to natural disasters as well as to law and order issues (illicit fishing, smuggling, migration, etc.). Norway may relocate its Home Guard units in order for them to be based closer to the most endangered areas on national territory.

In the Arctic, Norway expects increased demand for surveillance and reconnaissance operations – at sea by naval and coast guard vessels; in the air with manned and unmanned aircraft – as well as more use of spatial data. The U.S. expects more national HADR operations for the armed forces, such as search and rescue, but also increasing military involvement in the Arctic area for geopolitical reasons, including exercises with partner countries.

In Germany, when called, the armed forces can provide military support to the Länder (states) which have the prime responsibility for disaster response. Canada is already experiencing an increased call on the armed forces to respond to natural disasters, in terms of personnel as well as ships, aircraft, vehicles and other equipment that have to be made available. The average number of military emergency operations in Canada was six per year in 2017 and 2018. In the spring of 2019, more soldiers were deployed domestically than overseas. A further increase is expected, in particular in search and rescue operations (currently already 9,000 calls annually).

The Jordanian Armed Forces have a dedicated Energy and Water Directorate to address the issues related to environmental matters and operations. Forecasts point to an increased call on the armed forces to assist the civil authorities in disaster operations.

TABLE 1- EMERGENCIES THE MILITARY IS LIKELY TO BE CALLED UPON IN CIVIL-MILITARY OPERATIONS ON THEIR NATIONAL TERRITORIES (INCLUDING OVERSEAS TERRITORIES)

1. Forest and wildfires
2. Flooding
3. Rock slides
4. Search and rescue
5. Power cuts
6. Illicit activities
   Trafficking, smuggling, migration, fishing, pollution (Australia, France, and New Zealand)
7. Surveillance and reconnaissance of the Arctic region
   (Particularly in the case of Norway and the United States)

INTERNATIONAL MILITARY OPERATIONS

Humanitarian assistance and disaster relief (HADR) operations will increase, but in some nations, this will not automatically lead to more involvement of the armed forces as international HADR missions are considered to be primarily a civilian and NGO matter. This is the case in Finland, Norway and Sweden. France and the United Kingdom are taking into account that the armed forces might have to assist international emergency HADR operations more often, but both countries also expect that conflicts resulting from climate change will have an impact on crisis management operations. Deployed forces might be confronted by increasing human security problems (lack of food and water, diseases, etc.), which will call for more CIMIC (civil-military cooperation) activities. Germany has the same view.

Australia and New Zealand regard international operations in response to the effects of climate change as an extension of the tasks on or near national territory: HADR and rule of law related operations. In both cases, working closely with armed forces of partner countries in the region is a necessity. The FRANZ agreement stipulates military cooperation between France and Australia. New Zealand is extensively involved in activities on Antarctica - a demilitarized zone, but climate change will have an impact on military support such as air transport.

Norway emphasizes the increase in surveillance and reconnaissance operations due to the melting of the Arctic, which is driven by the geostrategic impact of climate change in the region rather than by natural disasters. Canada expects greater demand for peace (support) or stabilization operations as well as more HADR missions worldwide.

The geographic combatant commands of the U.S. Armed Forces are already taking climate change effects into consideration in contingency planning for operations (Africa, Indian Ocean, Arctic). Extreme weather effects might reduce available flight hours, affecting transport of logistics and other mission support.

PERSONNEL AND EQUIPMENT

In terms of climate change impacts on personnel and equipment: first, this is very much dependent on where the armed forces are deployed; second, the geographical location, once more, is a major factor of influence. Countries with a tradition of overseas deployments automatically take different climate circumstances into account, such as with regard to clothing and other personal equipment. Operating in desert areas, such as in the Sahel or in Afghanistan, requires dedicated training of crews to fly helicopters in sandy and dusty environments. Maintenance is also affected by such challenging operational circumstances.

France seems to be most advanced in taking climate change into account with respect to personnel and equipment: since the late 1990s climate change together with other environmental conditions have been taken into account by the Directorate General of Armaments in developing military equipment. The FREMM frigates with a reduced fuel consumption and the Eco Camp 2025, intended in particular to develop energy and water security of overseas military camps, are two examples. The UK is perhaps the next in line. The country reduces fossil fuel consumption by increasing virtual or synthetic training and through modernization of equipment. Operations in areas with higher temperatures will set improved cooling demands for aircraft, ships and vehicles. The Defence Equipment & Support (organization) is taking climate change impacts into account and environmental requirements have been defined in a publication for the defence industry.

Finland, Norway and Sweden are taking the effects of climate change into account in these areas, but primarily for military operations on national territory or adjacent sea areas (the Baltic Sea and the Arctic waters), both in terms of personal equipment and weapon systems. Norway is investing more in the navy, such as by purchasing new maritime patrol aircraft and coast guard vessels for an increased presence in the Arctic. Improving communications in the Arctic by using satellite communications is another defence planning requirement based on the changing climate conditions in the High North. In Finland, milder climate conditions in the south of the country may impact training conscripts, as they will face less snow and ice than their predecessors encountered in the past. Sea level rise is already a criterion for planning new infrastructure for Finnish forces: the Finnish Squadron 2020 project states that no new infrastructure will be built below three meters above the (current) sea level. Naval ships should be able to sail in storms with ice conditions.

Australia is also looking at the consequences of sea level rise, flooding, storm surges and coastal erosion for the infrastructure of the armed forces. Rising temperatures and heat waves will have a profound effect on the mental and physical health of personnel. A peculiar requirement regards the availability of more cultural advisors to the military, specifically trained in refugee experiences and resettlement. The Parliament in Australia has played a proactive role in recommending that the Ministry of Defence identify and to take into account climate change effects. In New Zealand, climate change is a factor influencing the Defence Capability Plan and the Defence Equipment Plan. New Zealand, for example, will upgrade surveillance and communications systems, procure a second ship equipped for HADR operations, a new patrol vessel capable of operating in Antarctica and other relevant equipment.

Canada already has difficulty recruiting sufficient military personnel. For that reason, the Ministry of Defence wants to enhance the role of reservists in assisting with responding to natural disasters on land and at sea. This is necessary in light of the expected increase of extreme weather events leading to more calls for assistance by the military.

In Jordan, high temperatures (40-45 C) will impact personnel and equipment. For example, fighter aircraft engines are affected, which is currently addressed by adjusting the length and direction of runways. Clothing needs to be adjusted in order to be adaptable to changing weather, from extreme heat to heavy rainfall and flooding. NGOs are helping to train the military to adjust their behaviour to the changing environment, for instance, to be more selective in using scarce clean water resources in the desert. The Jordanian army has a lot of experience with operating in water scarce environments from which other countries could learn.

The U.S. has conducted a review of all military installations in terms of climate change effects. Opening up (northern) sea routes will increase procurement costs of vessels and other equipment. The lack of nuclear-powered icebreakers is a specific point of concern that added to a decision not to undertake a Freedom of Navigation Operation (FONOP) through the Arctic. It was realiz ed that lack of icebreaking capacity and dependence on Russian search and rescue capabilities in the Arctic would be too much of a risk. On national territory, extreme heat – in particular in the South – will affect training and exercises. Other extreme weather effects can also impact training.

"GREENIFICATION" OF THE ARMED FORCES

Several of the twelve case-study countries have sustainable energy targets, often related to government-wide defined objectives (see table X for an overview). France launched a Sustainable Defence Strategy in 2016, defining a number of challenges and related goals for the Ministry of the Armed Forces. The UK has a Sustainable MoD Strategy, which directs concrete measures to be taken, in particular, focusing on reducing the amount of energy consumed.The Modernising Defence Programme describes how the MoD can deliver better capabilities and value for the same amount of money in a sustainable way.

Norway has taken very little action in making its armed forces greener. There is one green compound (energy production based on biomass fuel). By contrast, Finland has a national target of heating all government buildings without using fossil fuels by 2025. The Ministry of Defence is bound to realize this target for all its buildings. Planning is underway to reduce energy consumption of the armed forces during operations.

Sweden is in the study phase of making its armed forces greener. National targets have to be taken into account but are not binding for the armed forces. The Defence Material Administration (FMV) is working on the reduction of energy use by military infrastructure, which accounts for about one-third of the Swedish Armed Forces' fuel consumption. Australia is reducing fossil fuel consumption of the armed forces and their associated infrastructure – the latter in particular by equipping buildings with solar panels. New Zealand, like Australia, has defined general objectives to make the armed forces greener, but no concrete targets have been set so far. The New Zealand Defence is, however, committed to establishing a method of measuring carbon emissions. When its emission profile is completed, the Defence aims to aid and assist emission reduction initiatives.

Canada has already made progress in greening its defence infrastructure and its commercial vehicles. Officially, the Ministry of Defence is exempted from national greenhouse emission targets, but as of the autumn of 2019 it has started to publish its fleet emissions. The Defence Energy and Environment Strategy (2017) outlines a number of objectives and related goals for the contributions of the Canadian Armed Forces to greenification.

The U.S. Armed Forces are making an attempt to reduce the carbon footprint, despite the country stepping out of the Paris Climate Agreement. E.g. the U.S. Navy has introduced a green programme to reduce its reliance on fossil fuels.

A particular contribution of the Jordanian Armed Forces has been the planting of 250,000 trees in the country (such as in fields cleared of mines) and 2.5 million trees in military camps across the country to prevent desertification. This is possible because the country has a relatively large standing army which is currently not engaged in active warfare. Jordan's military also participates in cross-border environmental conservation projects with neighbouring countries which help to strengthen the cooperation between various communities and, thus, has a peacebuilding effect.

MATRIX – DEFENCE SUSTAINABLE ENERGY TARGETS

	GREENHOUSE EMISSION	FOSSIL FUEL	OTHER
AUSTRALIA	-8% (2019)	-	-
CANADA	-40%[1]	-50%(2030)[2]	30% ELECTRIC[3]
FINLAND	-30% (2020)[4]	-	-20% ENERGY IN BUILDINGS
FRANCE	-40% (2030)	-40% (2030)[5]	50% ELECTRIC/HYBR. VEHICLES (2030)
GERMANY[6]	-	-	-
JORDAN	-	-	-
NETHERLANDS	-20% (2030)[7]		BY 2030 COMPOUNDS SHOULD GENERATE 50% OF THEIR OWN ENERGY. BY 2050 THEY SHOULD BE FULLY SELF-SUFFICIENT IN ENERGY SUPPLY
NEW ZEALAND[8]	-	-	-
NORWAY	-	-	-
SWEDEN	-	-100% (2045)[9]	-
UNITED KINGDOM	-30% (2020)[10]	-10% (2026)[11]	-
UNITED STATES	-	-	-

CONCLUSIONS

Our review of efforts in 12 countries makes clear that often times climate change not only acts as a threat multiplier in theaters of operations, but has direct implications for military capabilities since it also leads to additional domestic calls for assistance to civil actors. In some cases, it can even directly affect military capabilities and strength, since extreme weather and floods place a substantial additional burden on the overall capacity to act.

The extent to which the military capabilities of countries are affected by climate change is related to how they respond and if they integrate climate change impacts into their defence strategies and policies, and more specifically into risk assessment, early warning, surveillance, and operational preparations. It is also related to their general efforts in climate adaptation, disaster preparedness, and risk reduction, even though some impacts might be difficult or impossible to entirely brace for.

Militaries also contribute to climate change with their own emissions and while some countries have greenhouse gas emission reduction targets for the defence sector, others do not. It seems that countries who have not yet or who are reluctant to undertake adjustments to prepare for climate change, insufficiently realize the undermining impact on their military capabilities. The inability of the U.S. to undertake a freedom of navigation operation in Arctic waters due to a lack of nuclear-powered icebreakers and dependency on Russian search and rescue illustrates this lack of preparedness.

With regard to the approaches and experiences of other countries, the proactive posture of France stands out. It is very advanced in its thinking and action to prepare for and address first and second-order drivers of climate-security. New Zealand can also be referred to as an early mover, with climate change featuring most prominently in its most recent defence implementation plan on climate change. The UK, Finland, the Netherlands and Canada are relatively ahead of the curve as well, and the U.S. had done a lot of work under the previous administration, but has slowed down in recent years. Jordan is very experienced when it comes to the ability to operate in hot and water-scarce regions. Its army has also realized the potential contribution of nature conservation to peacebuilding efforts.

Sweden and Germany have some forward momentum on the issue, with their defence ministries open to stepping up with regard to addressing the climate-security dimension, in line with their diplomatic efforts in this field. Australia and the U.S. seem most severely affected by extreme weather events aggravated by climate change, and continue to address climate risks to military equities, but have slowed down actions due to political changes. Future analysis by the IMCCS Expert Group may assess to what extent climate change undermines military capabilities, including the military organizations of other countries.

NOTES

1 Compared to 2005 levels
2 At deployed compounds.
3 For light vehicles to run on electric energy fully or partially.
4 Compared to 2010 levels.
5 Both compared to 2012.
6 No specific Defence targets but for buildings the Ministry of Defence applies the national CO_2 reduction targets (-55% by 2030, -70% by 2040 and -80-95% by 2050; all compared to the 1990 level).
7 Compared to 2010 levels.
8 No specific Defence targets but the MoD has to apply the national zero carbon emission target (2050).
9 National target, not binding to the Swedish Armed Forces.
10 Target set by the Greening Government Commitment. A percentage of 36% has already been realized.
11 The original target of 18% reduction against the 2009-2010 baseline has been exceeded in 2017-2018. The 10% reduction target for 2026 is based on the 2015-2016 baseline.

V. CONCLUSIONS AND RECOMMENDATIONS: GLOBAL SECURITY COOPERATION

This report highlighted the significant risks to global security posed by climate change, but also the significant opportunities for global security cooperation.

As evidenced by a range of recent events and reports from government, academic and nongovernmental institutions, the security consequences of climate change are hitting harder and more quickly than anticipated.[1] Climate security cuts two ways: as climate change makes it more difficult for people to cope with the hardships of instability and conflict, instability and conflict makes it very difficult for people and nations to adapt to climate change, particularly in nations that are marked by a high level of fragility. As explained in a recent report by the U.S. Agency for International Development:

> *"...fragility results when interactions between state and society fail to meet critical public needs, and the public accordingly perceives outcomes as illegitimate, ineffective, or both. Countries with high levels of fragility often have weak institutions and limited capacity to respond to climate-related challenges. Meanwhile, challenges posed by climate change and variability may heighten fragility by further straining a state's capacity to govern effectively and legitimately."* [2]

In writing this report, the authors repeatedly encountered two dominant risks that are already straining societies around the globe, and which could lead to significant or higher risks to global security if unaddressed as the climate continues to change. Those two risks are water security and food security. From Mexico City to the Iraqi countryside, Mali to Yemen, Ho Chi Minh City to Cape Town, water and agricultural systems and fisheries are already faltering, and millions of people are on the brink. Climate-related shocks from extreme weather events like heat and drought to torrential downpours and flooding, are stressing the resilience of these communities, causing some to fall prey to the lure of extremists, who pay wages and offer respite from the unrelenting challenges of earning a livelihood from a land or a sea that no longer yields what it used to. As climate change deepens, we can only expect these integral systems to be more disrupted.

There is a silver lining. Many militaries and security institutions around the world have begun to take the security risks posed by climate change seriously, as evidenced by a range of climate change studies, planning and strategic documents, and investments, made by militaries in recent years,[3] and the very existence of the International Military Council on Climate and Security, which currently includes military representatives from over 30 nations.[4] There is growing awareness of the increasing severity of climate events and a nod to frightening scenarios such as the potential for a devastating typhoon hitting vulnerable countries like Bangladesh or the Philippines which could cause millions to be displaced or even to migrate permanently. However, there is more to be done in order for the response to rise to the level of the threat, which has been deemed significant-to-catastrophic in the next two decades by the military and security experts surveyed in this report.

In addition to the impacts of climate change-related shocks, this review found that climate mitigation and adaptation decisions taken will also be consequential. How the world mitigates and adapts to climate change does not have to create winners and losers, but if implemented without care, such decisions could exacerbate regional and global instability. Thus, the potential security risks of maladaptation should be acknowledged and addressed up-front.

Finally, the report identified an urgent need for cooperation among nations and coordinated action among agencies and institutions; it requires whole-of-society response. Currently, that need is challenged by both a rise in authoritarianism and great power competition. Nonetheless, there is also a countervailing trend of security and military institutions, as well as other important elements of society such as cities and key industries, taking climate change more and more seriously. This lays the groundwork for more global security cooperation, rather than competition.

For this reason, our overarching recommendation is that national, regional, and international security institutions and militaries around the world should acknowledge climate security risks and advance climate resilience, especially water and food security and their associated effects on stability, conflict and displacement, in their primary mission sets or lines of effort.. This would signal unequivocally that addressing climate change impacts is not only permissible by security actors, but absolutely central tasking for any security force or security focused institution. By identifying climate resilience as one of a handful of main lines of effort with which militaries and security organizations are tasked, the bureaucracies, institutions, and funding can line up underneath this mission and finally mobilize the resources that are needed to tackle the threat. This recommendation is not an attempt to manipulate the system, or to bend security institutions to deal with things they are not meant to do. As discussed above, preventing climate-driven national, regional and global instability should be a central responsibility of security actors, not an afterthought.

Under this overarching umbrella, the IMCCS Expert Group offers the following three categories of recommended actions. They are organized along familiar climate lines and speak to the particular role security actions can play in those dimensions.

FULFILLING PARIS COMMITMENTS AND BEYOND: SECURITY INSTITUTIONS CAN LEAD THE WAY

As a proven platform for innovation, military institutions are well-suited to be leaders on addressing climate change. Militaries have been the market driver for many technologies we take for granted today and can do so again with a powerful demand signal for innovation. Militaries investing in climate resilience and reducing emissions can also save lives and reduce operational costs, and help minimize logistical footprints, thus reducing risks for militaries and positively affecting surrounding civilian communities.

- Five out of the 12 militaries examined in this report have emissions reduction targets, fuel use targets and force electrification goals. Military institutions across the globe should build on that, calling for their societies to address the climate threat by advancing comprehensive emissions reductions goals in order to avoid significant security disruptions. Militaries can also lead by example through advancing impactful mitigation strategies, to include non-tactical emissions reduction targets.

- Regional security institutions and alliances should also organize around planning for the security implications of climate change, as well as promoting meaningful emissions reductions that enhance mission effectiveness. This climate diplomacy could include military to military engagement with the non-EU G20 economies that make up 75% of global emissions.

- Consistent with mission and training requirements, militaries should also actively manage their land holdings to simultaneously improve installation resilience, and maximize carbon sinks and groundwater recharge.

CLIMATE-PROOFING POLICY: INTEGRATING & PRIORITIZING CLIMATE IN SECURITY DECISION MAKING

Develop standing whole-of-governance mechanisms to assess, prepare, prevent and respond to climate security threats in a way that allows whole of government alignment on climate-related missions in "supported and supporting" relationships between security forces, development agencies, agricultural and environmental ministries, etc. Distribute resources, responsibilities and authorities in an equitable, effective manner, tailored in a way most suited for the particular national context.

- Incorporate climate and security considerations into national security and foreign policy calculus. Potential climate changes should be considered in every decision made on every topic. History has taught us that not considering climate can lead us to miss climate's contributions to security challenges as we did in ISIS recruiting efforts in Iraq, as well as cause us to miss innovative solutions to previously intractable security problems as in Colombia.

- The report highlights how water and food security will increasingly drive security threats. For this reason, agriculture and interior ministers must be integral participants in national security and foreign policy decision making to include membership in national security councils and bodies.

- Climate-proof development assistance, and build more resilient communities in the most vulnerable nations which are likely hotspots of instability and conflict. Assistance should be aimed at climate resilience challenges like water and food security, and disaster preparedness, and be as carbon neutral as possible.

- The international community should embrace a Responsibility to Prepare and Prevent, given unprecedented foresight capabilities regarding the unprecedented risks of climate change.[5] This includes ensuring all levels of government and civil society, including all national, regional and international security institutions, are prepared for the security implications of climate change.

LEADING A PARADIGM SHIFT: MILITARIES INTEGRATING CLIMATE CHANGE INTO MISSION SET

Coping with the effects of climate change stresses militaries in every conceivable way. Militaries are increasingly called upon to respond to climate related catastrophes both at home and abroad. These missions not only compete with traditional security commitments and preparedness but also present fundamental challenges to those charged with properly manning, training, and equipping their forces. The effects of climate change impact readiness by disrupting carefully choreographed training, exercise, maintenance and deployment cycles and by diverting precious resources. The diverse set of skills required are not always easily interchangeable or transferable with traditional requirements. The report found that effectively integrating climate response into the way militaries operate requires a paradigm shift. A review of both the Climate Security Strategic Capability Game and 12 militaries revealed that capacity and capability to address the security dimensions of climate change is directly related to how and to what extent climate considerations are integrated into strategic plans, and more specifically into risk assessment, early warning, surveillance, and operational preparations to include adaptation measures to harden infrastructure.

- Give significant treatment to climate security issuese in security forums such as the UN Security Council, and NATO, ADMM Plus, as well as leading security conferences such as in Munich, Shangri-La, and Halifax.

- Add climate security curricula in national, regional training and defense colleges.

- Incorporate climate and security games and scenario simulations into national and regional security organization planning, training, and decision making.

- Integrate climate into armed forces risk assessment, early warning, surveillance, and operational preparations to include adaptation measures to climate-proof military infrastructure. Early warning and surveillance framework should also have the capacity to anticipate risks from emergent climate-manipulating technologies such as geoengineering.

The IMCCS Expert Group recommends that the world's security leaders act, decisively and with focus, to address the risks climate change poses to global security. Preventing, preparing for and responding to climate change should not be an after-thought. On the contrary, it should be one of a handful of any security institution's core missions.

NOTES

1 See the Center for Climate and Security Resource Hub and the Climate Security Expert Network: https://climateandsecurity.org/resources/; and: https://climate-security-expert-network.org/
2 Ashley Moran, Joshua W. Busby, Clionadh Raleigh, Todd G. Smith, Roudabeh Kishi, Nisha Krishnan, Charles Wight, and Management Systems International. "The Nexus of Fragility and Climate Risks." *U.S. Agency for International Development (USAID)*. Washington, DC, March 2019. https://pdf.usaid.gov/pdf_docs/PA00TBFH.pdf?mc_cid=9a663aa12f&mc_eid=d2eb3bc86b.
3 See the Center for Climate and Security Resource Hub: https://climateandsecurity.org/resources/
4 See a list of Participants in the International Military Council on Climate and Security here: https://imccs.org/council/
5 Caitlin Werrell and Francesco Femia. "The Responsibility to Prepare and Prevent: A Climate Security Governance Framework for the 21st Century." *The Council on Strategic Risks/ The Center for Climate and Security.* October 2019. https://climateandsecurity.org/the-responsibility-to-prepare-and-prevent-a-climate-security-governance-framework-for-the-21st-century/

THE CENTER FOR CLIMATE AND SECURITY

COUNCIL ON STRATEGIC RISKS

The International Military Council on Climate and Security (IMCCS) is a group of senior military leaders, security experts, and security institutions across the globe dedicated to anticipating, analyzing, and addressing the security risks of a changing climate. The IMCCS is co-led by a Secretary General and Chair:

IMCCS Secretary General
The Honorable Sherri Goodman
Former Deputy Undersecretary of Defense (Environmental Security)
US Department of Defense
Senior Strategist, The Center for Climate and Security

IMCCS Chair
General Tom Middendorp (RET)
Chief of Defence of the Netherlands
Senior Associate Fellow, Clingendael Institute

The IMCCS Expert Group consists of IMCCS leaders committed to driving analysis, policy and communications on climate and security, including through the development, publication and endorsement of the World Climate and Security Report, as well as other timely analysis driven by demand signals from the IMCCS. The IMCCS Expert Group currently consists of representatives from four institutions:

- The Center for Climate and Security (CCS), a institute of the Council on Strategic Risks (CSR)
- The Planetary Security Initiative of the Netherlands Institute of International Relations (Clingendael)
- *The Hague* Centre for Strategic Studies (HCSS)
- The French Institute for International and Strategic Affairs (IRIS)

This report should be cited as: "The World Climate and Security Report 2020." Product of the Expert Group of the *International Military Council on Climate and Security*. Authors: Steve Brock (CCS), Bastien Alex (IRIS), Oliver-Leighton Barrett (CCS), Francesco Femia (CCS), Shiloh Fetzek (CCS), Sherri Goodman (CCS), Deborah Loomis (CCS), Tom Middendorp (Clingendael), Michel Rademaker (HCSS), Louise van Schaik (Clingendael), Julia Tasse (IRIS), Caitlin Werrell (CCS). Edited by Francesco Femia & Caitlin Werrell. Published by the Center for Climate and Security, an institute of the Council on Strategic Risks. Feb 2020.