Managing Climate Risks for National Security: Resources, Data, and Connectivity**

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Summary

The Federal government spends hundreds of billions of dollars annually to support national security programs, infrastructure, and operations. Recognizing the threat posed by the changing climate, President Obama directed Federal agencies to assess and develop strategies to respond to climate risks across the three pillars of United States national security: development, diplomacy, and defense. These directives are outlined in various policy documents, including the 2014 Executive Order on Climate-Resilient Development, the 2015 Quadrennial Diplomacy and Development Review, and the 2016 Presidential Memorandum on Climate and National Security. Effectively responding to these mandates will require the Federal government to collaborate with academia, civil society, and the private sector to improve observational data collection, climate resilience assessment, integrated analytic capacity, and early warnings of systemic risks.

Current realities

The climate is a key determinant of many factors that shape modern society, including: the location of population centers, water availability, agricultural productivity, air quality, the distribution of disease, and the frequency and intensity of natural hazards such as wildfires, floods, and droughts.

As the climate changes, expectations about the natural world are becoming less reliable. Average daily temperatures have risen in some places by as much as 3° F since the pre-industrial era, while water resources have become more variable and unpredictable. Even with aggressive reductions in greenhouse gases, temperatures will continue to rise over the coming decade, precipitation will become more volatile, and the frequency and intensity of extreme weather events are expected to increase. Meanwhile, sea levels are projected to rise in some places by as much as two feet by mid-century, putting millions of people at risk of severe coastal flooding and displacement; the majority of those affected are likely to be in Asia. Together these shifts will undermine livelihoods, threaten infrastructure, increase food insecurity, and compromise the ability of states to provide the necessary conditions for human security.

Minimizing the climate stresses that are escalating security concerns requires reducing emissions of the greenhouse gases that are causing the climate to change. However, over the near term, even as emissions are being reduced, due to the inertia of the climate system, climate risks will need to be managed primarily through preparation and adaptation.

Many of the most challenging climate security threats will be systemic. Weather events in a given region do not occur in isolation. They are part of the global climate system that is changing. Changes in one location are connected to changes in weather patterns around the world. Meanwhile, our hyper-connected economy and globally networked society create multiple pathways for local climate-related stresses to trigger socioeconomic and geopolitical instability elsewhere. Seemingly unrelated events — a once-in-a-century drought in China, record rainfall in Canada, and drought and wildfires in Russia — can trigger conditions of civil unrest in distant lands. In 2010, these synchronous climatological events led to a dramatic reduction in wheat production and contributed to a rapid rise of global wheat prices, which many analysts believe helped spark the Arab Spring.

Most of the links between climate and national security are ambiguous and are likely to remain so, even as the signal of climate change grows. We will never know exactly how significant weather shocks and other climate-related factors were in sparking the Arab Spring. When it comes to assessing the impacts of a changing climate on society, simple cause-and-effect descriptions of events break down. Floods, heat waves, and droughts can create fragile conditions or exacerbate existing fragile situations. The changing climate is increasing the odds that these fragile conditions will arise and the likelihood that they will be severe.

Scientific opportunities and challenges

The national security community, which includes actors in development, diplomacy, and defense, often seeks a level of specificity of climate information that scientists have traditionally found difficult to provide. Emerging trends in science and technology, however, present new opportunities for addressing these challenges.

First, the capacity to collect and analyze data is growing exponentially. Small and inexpensive satellites are, for the first time, creating widespread access to high-resolution imagery of the Earth. Meanwhile, "big data" has created opportunities to analyze societal changes and exchanges in new ways — factors that can be important in characterizing social vulnerabilities to climate-related stresses. These changes in how information is collected, coupled with the increase in computational capacity and the growing sophistication of machine learning, are transforming society's ability to identify climate-related threats early and respond to them effectively.

Second, the spatial resolution of available climate information is becoming increasingly more granular. The resolution of global climate models (GCMs), typically 100-300 km^2, is too coarse for most national security applications. Over the last decade, scientists have improved techniques to "downscale" GCM projections to much finer resolutions (meters to tens of kilometers). However, the validity of downscaled projections in a given location depends on the quantity and quality of local observational data, which is often limited in the most vulnerable regions of the world.

Third, scientists' understanding of the determinants of climate resilience is improving. While climate projections are integral to identifying climate vulnerabilities, understanding society's resilience — the capacity to absorb and respond to climate-related shocks — is perhaps more critical. Research is increasingly focused on understanding society's resilience to climate stress.

Despite the promising scientific and technological advances in understanding climate risks and vulnerabilities, there are significant challenges in the design and implementation of effective response strategies. Examples include:

The ability to provide detailed near-term predictions of climate-related risks is limited. Seasonal (several months to a year) and decadal (several years to decades) forecasts, unlike weather forecasts, do not provide specific daily weather predictions. Rather, they provide estimates of the mean statistics of future weather conditions, relative to normal conditions (i.e., drier or hotter than normal), which may be of only limited use in some operational settings. Furthermore, the accuracy of these forecasts is still poor, with inter-annual and decadal forecasts still mostly in research mode.

The uncertainties in climate projections will likely persist for many years. Research is continuously uncovering a more detailed and complex picture of the climate system. As scientists have integrated these complexities into climate models, their confidence in the climate projections has increased, even though the precision of the projections has not.

Despite, or perhaps because of, the recent proliferation of climate information, communities around the world are often unable to determine which data to use and how to use them. Which data are most appropriate in a given situation depends on the specific questions being asked. Many of the most vulnerable communities do not have access to experts who can identify and appropriately apply the climate information. Using the wrong data or applying data inappropriately can lead to maladaptations, resulting in potentially significant social and/or economic consequences.

Traditional climate assessments often fail to capture systemic risks. Climate assessments typically look at a specific region or sector, focusing less on the connections among them. Yet, as the intensity and frequency of consecutive and/or synchronous climate-related stresses around the world increases, the greatest security risks may arise from the interaction of regions and sectors through a number of pathways, such as global food markets and supply chains.

Climate resilience is a nascent concept that has been difficult to operationalize at scale. Although international policy frameworks, such as the United Nations Paris Agreement on climate and the Sustainable Development Goals, have prioritized climate resilience, the ability to identify and track changes in climate resilience is limited. Existing methods for characterizing resilience globally, such as the Notre Dame Global Adaptation Index (NDGAIN) and the Climate Vulnerability Monitor index, can be helpful in identifying high-level trends, but are often too course in resolution and too generic in their characterization to be useful for prioritizing climate resilience investments or identifying strategic vulnerabilities.

Policy Issues

A critical component of responding to the security threat of climate change will be building a culture that embraces the inherent uncertainty and ambiguity of the climate crisis in policy, planning, and operations. The following policy actions would advance these issues:

- *Expand and improve the collection of Earth observations and socioeconomic data*. Both biophysical and socioeconomic data are critical for effectively modeling, monitoring, and responding to the risks of a changing climate. Large data gaps, especially in the developing world, must be filled. Traditional data collection approaches are critical and need to be expanded. Such approaches can be scaled and complemented with remote and digital sources, while respecting privacy issues.

- *Invest in a coordinated effort to improve society's ability to assess and monitor climate resilience.* Methods to assess society's capacity to absorb or respond to these stresses are relatively nascent. A practical method is needed for assessing the resilience of specific places to specific climate-related risks in a manner that can be applied to other regions — at scale.

- *Develop a robust, integrated, analytic capacity to assess, on an on-going basis, the climate-related vulnerabilities relevant to development, diplomacy, and defense.* The central authoritative source of global climate information is the Intergovernmental Panel on Climate Change (IPCC). However, it is often too general and too outdated to effectively inform specific response strategies. Integrating climate risks into national security decisions requires starting with the questions, not the data. Such a problem-driven approach necessitates a dedicated team of climate and social scientists, and national security analysts working together to define and respond to specific questions most relevant and pressing for development, diplomacy, and defense, using the most current science.

- *Strengthen global capacity to develop early warnings of climate-related systemic risks.* Certain regions of the world pose greater security risks than others at any given time. Understanding how climate influences security risks in any of those regions requires a global view, as the increased frequency and intensity of synchronous climate-related stresses from distant regions may impose unexpected stresses on otherwise fragile states through secondary pathways such as trade, disease, or social networks. As the frequency and intensity of climate-related shocks increase, developing an early warning system for systemic climate-related stresses will be important.