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# A Framework for Climate Security

## Introduction

Climate security—defined here as the intersection of climate change and national security—is a complicated issue, with a vast number of elements, and a complex tangle of interrelationships. Establishing a framework to relate the potential environmental effects of climate change to DoD’s broader challenges can make it easier to grasp the climate security considerations. While we do not claim to have *the* framework for understanding climate security, here we offer *a* climate security framework.

To establish our framework, we first defined specific changes to the physical environment, driven by climate change, in terms relevant to DoD. Next, we identified four broad categories that capture the range of climate challenges for DoD, to show how diverse those challenges can be. Focusing on just one challenge—*impact on operations*—we provide an example of how this framework can support detailed assessments.

## The Complexity of Climate Security

The complexity of climate security derives from the vast span of human activity affected by climate change, which includes economic growth, infrastructure, public health, finance, and energy. For example, in the energy sector alone, climate can be linked to [record demand](#) for electricity during heat waves, [power cuts](#) to reduce the chance of wildfires, and a major shift [away from coal](#) for electricity generation in the United States.

Accentuating the complexity are the unavoidable uncertainties associated with forecasting future changes to the climate. One example would be the various feedback loops that worry scientists, such as warmer temperatures thawing permafrost. As permafrost thaws, it [releases methane](#), a powerful greenhouse gas, which in turn further warms the atmosphere. The recently released Intergovernmental Panel on Climate Change (IPCC) [Sixth Assessment Report](#) highlights the complexity: “The magnitude of feedbacks between climate change and the carbon cycle becomes larger but also more uncertain in high CO<sub>2</sub> emissions scenarios (very high confidence).”

The impact of climate change on human activity touches on most of DoD’s portfolio. The National Guard’s leadership [has to worry](#) about its response to increases in various natural disasters and extreme weather events, while accounting for how those same disasters may hinder the functionality of National Guard facilities (e.g., power outages). An increasing number of days with high heat and humidity levels may lead to more “[Black Flag](#)” restrictions on training, hampering the training pipeline and degrading readiness. Climate stresses may [destabilize](#) nations or spark mass migrations, potentially changing DoD’s demand signal for certain missions. Commanders will have to account for a changing climate during operations

and planning, whether that be reduced sea ice in the Arctic, higher heat and humidity, or transportation infrastructure damaged by severe storms.

In sum, climate security has a great many facets and interdependencies, which can make it difficult for any analyst or decision-maker to understand, and decide how to approach this challenge.

### Step 1—Define Climate Effects

Our first step to bring some clarity to considerations of climate security was to define climate change into specific changes to the physical environment at a level of detail needed to understand implications for DoD. Below are the 13 changes we identified as relevant to DoD, organized by physical domain. Note that it is not the characteristics of the physical environment themselves that are of primary interest in this case—military officers since Alexander the Great have had to factor in things like heat and humidity while marching their forces long distances. Rather, the important factor here is how these characteristics are *changing*, and thus how field commanders, base commanders, and force planners may need to adapt. The changes listed below were drawn from authoritative sources on climate change, such as the [Fourth National Climate Assessment](#) (2018) and the IPCC's [Sixth Assessment Report](#) (2021).

#### Changes to the Air

- Higher air temperature and humidity
- Shifting precipitation patterns (e.g., longer droughts, more intense rain or snow events)
- More severe storms or tornadoes
- Hurricanes (e.g., stronger, more rapid intensification)

#### Changes to the Land

- More wildfires
- Expanded range for diseases
- Decreasing ice sheets on land
- Thawing permafrost
- Increased coastal erosion

#### Changes to the Oceans

- Rising sea level
- Changing ocean currents
- Changing ocean salinity, pH, and temperatures
- Decreasing sea-ice extent

Note that these are changes to the physical environment. Constructing the list in this way allowed us to keep it homogeneous, but doing so leaves out possible secondary effects, namely, implications for, or reactions from, humans. Rather than try to map changes in the environment

to possible human reactions, we provide a separate list of possible implications from the 13 physical changes. At a broad level, these secondary effects can be seen by DoD as threats to DoD's resources or as drivers of demand for various DoD missions (e.g., humanitarian assistance and disaster relief):

- Weakened or collapsed states
- Mass migration
- Loss of economic productivity
- Resource wars
- Costly public health problems
- Costly loss of infrastructure

Using these two lists can help you decide which aspects of climate change are in scope, relative to your specific challenges.

## Step 2—Define DoD's Broader Challenges

Our next step was to create four broad categories, into which the wide array of DoD climate security challenges could be binned. These categories bring attention to some topics that might otherwise be overlooked, and highlight how some of these challenges differ. These categories differ considerably, but they are all serious challenges faced by DoD.

*Impacts on Installations:* This challenge understandably receives a great deal of attention within DoD, given how important installations are, their vulnerability to a range of environmental changes, and DoD's tremendous investment ([~\\$1.2 trillion global replacement value](#)). For example, in 2018 [Hurricane Michael](#) rapidly intensified from a category 2 to a category 5 hurricane, just before its direct landfall on Tyndall Air Force Base in northern Florida. The Air Force's initial repair funding of \$600 million was just a down payment on the 5+ year repair effort to return the base to pre-storm functionality.

*Impacts on Operations:* We found it important to have a separate category for operations, to preserve some attention for forces in the field. Installations are an instinctive focus for DoD, but care must be taken to not neglect what happens when forces operate away from a base. For example, what happens to operations in the Middle East requiring a large number of helicopters when already high temperatures climb even higher?

*Demands on DoD Per National and Global Priorities:* Not all the climate security challenges faced by DoD tie directly to its operations or installations. At times, Congress or the President can require that DoD take climate change mitigation actions, such as lowering its carbon footprint or using its ample buying power to spur the growth of green industries. Although such actions may generate some benefits for DoD installations or operations, their primary purpose is to generate positive effects outside DoD.

*Impacts on Foes, Allies, and Partners:* DoD’s approach to climate security must include how these others are affected, on an absolute and relative basis. For example, in a U.S.–China conflict in the 2030s, will the People’s Liberation Army infrastructure be worse off from sea-level rise than that of the Japanese Self-Defense Force?

Early in one’s assessment, ask yourself where you are in these categories.

### Step 3—Sample Drill-down: Impacts on Operations

To explain how the categories defined above can be used to understand climate security, we present an example focusing on *Impacts on Operations*, cross mapping the seven joint functions defined in [JP 3-0 Joint Operations](#) (see Figure 1) to the 13 changes to the physical environment listed above (but not the second list of secondary reactions). For this example, we used our own subject-matter expertise to assess the impact of each climate-change event on each joint function. Table 1 shows scores for the impact in each of the 91 possible interactions: 1 point for minor impacts, 2 for moderate impacts, and 4 for major impacts. We identified some notable level of impact on a joint function for approximately half the 91 cells.

While many of the impacts we foresee will be negative for the U.S. military, there are some positives. For example, the decreasing sea-ice extent may provide new options for shipborne transport in the Arctic, a region with a paucity of ground transportation infrastructure. Table 1 does not distinguish between positive and negative impacts.

We tallied the scores for each column (the functions) and each row (the climate changes) to determine which functions are expected to be most affected by climate-induced environmental changes and which environmental changes had the broadest impact. Three joint functions and one climate change stood out.

<b>Climate Change Effects</b>		<b>Joint Functions</b>							<b>Score</b>
Minor impact on operations (1 point)	1	Command and Control	Information	Intelligence	Fires	Movement/Maneuver	Protection	Sustainment	
Moderate impact on operations (2 points)	2								
Major impact on operations (4 points)	4								

Changes to the Air	Higher air temperatures and humidity		1			2		1	4
	Shifting precipitation patterns (droughts, heavy rain/snow)		1	1		2		2	6
	More severe storms or tornadoes		1	1				1	3
	Hurricanes (e.g., stronger, more rapid intensification)		1	1		2		2	6
Changes to the Land	More wildfires		1	1	1	1	1	1	6
	Expanded range for diseases			1				1	2
	Decreasing ice sheets on land			1				1	2
	Melting permafrost		1	1		1		2	5
	Increased coastal erosion		1	1		1		1	4
Changes to the Oceans	Rising sea level							1	1
	Changing ocean currents			1		1		1	3
	Changing ocean salinity, pH, and temperatures			1	1		1		3
	Decreasing sea-ice extent	1		2	2	4	2	2	13
<b>Score</b>	<b>1</b>	<b>7</b>	<b>12</b>	<b>4</b>	<b>14</b>	<b>4</b>	<b>16</b>		

### Joint Functions

*Intelligence (score 12):* An important element of intelligence is providing information on the natural environment. The changing climate is likely to require greater attention in intelligence activities. Some facets of the environment may change faster, requiring more frequent updates to intelligence products, or some changes may reach a magnitude that requires a higher resolution treatment in intelligence products. One example would be increased coastal erosion. Stronger storms and more frequent intense rainfall events will increase the rate and or magnitude of coastal erosion in some locations. This in turn may require more frequent updates to map products needed to inform land maneuver and amphibious assaults.

*Movement/Maneuver (score 14):* Higher peak temperatures can force reductions in the movement and maneuver of personnel and equipment, and extreme weather (e.g., heavy rain or snow, hurricanes) can destroy or paralyze transportation infrastructure. A recent example occurred in Japan in January 2021, when [extreme snowfall](#), up to 6 feet in some locations, trapped 1200 civilian motorists on roadways. The most pronounced impact on movement comes from decreasing sea-ice extent, the only climate change, joint function pairing we rated

as having a *major* impact on operations. These impacts are largely limited to the Arctic, the one polar region centered on an ocean, but those impacts are profound. The Arctic sea-ice minimum, when the surface area of the ice is at its lowest (usually in September) has been declining by *13% per decade*. While submarines have long operated year-round in the Arctic, surface ships have been limited to brief periods in the summer or to a few icebreakers. But now, those seasonal windows of little or no sea ice are getting longer, and the areas viable for non-ice-hardened ships are getting larger, essentially adding a new ocean for surface ships. Submarines are affected as well, because there is less sea ice to protect them from prowling aircraft or surface ships.

*Sustainment (score 16)*: We found changes in the climate to have very broad impacts on sustainment, 12 of the 13 climate change effects generating some level of impact. Examples of these impacts include ground-supply convoys hampered by bridges and roads washed out by intense rainfall or large wildfires increasing the frequency or scale of logistics-heavy defense support to civil authority missions. But some examples are beneficial, such reductions in sea-ice extent opening up new potential sea lines of communication.

### **Climate Effects**

*Decreasing Sea Ice Extent (score 13)*: With a score more than twice that of any of the others, this climate change stood out. We judged that decreasing sea ice will affect six of the seven joint functions, five of those at a moderate or major level. Note that the contrast between how we scored decreasing sea-ice extent and rising sea level is perhaps the best evidence we offer as to why one needs separate categories for assessing climate-change effects on installations and operations. To the commander of a large naval base, sea-level rise could be viewed as an existential threat. But on our list, sea-level rise was dead last in scoring—to the submarine captain at sea, another 18 inches of seawater over his vessel are largely irrelevant.

### **Supporting Detailed Assessments**

This climate effects, joint functions comparison example shows how even a modest level of assessment, if structured well, can begin to yield insights useful for DoD, while also illuminating where more in-depth analyses are warranted. The same approach used to evaluate operations could be applied just as usefully to missions, geographic areas, time periods (e.g., near, mid, far), Services, or other areas of interest to the DoD. One could also replace the changes to the physical environment used in this example with human reactions to the climate or a mix of the two. In short, the inputs can be customized to meet analytical needs.

### **Conclusion**

Determining the effects of climate change on DoD is analytically difficult, with a span that seems to touch everything, and a complex web of interdependent subtopics. Our framework begins by breaking down climate change into specific physical effects relevant to DoD. Then we

described four broad challenges that can be encountered within DoD, designed to show how different these can be, and to prevent some challenges from being overshadowed by others. Last, our drill-down into the operations category demonstrates how the other elements of the structure can be used for more in-depth assessments. We hope this structure gives you the tools you need the next time you're told to "address climate change."



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