THE SECURITY IMPLICATIONS OF GLOBAL CLIMATE CHANGE

Workshop Summary

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Center for Global Security Research
LAWRENCE LIVERMORE NATIONAL LABORATORY

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The Center for Global Security Research (CGSR) at Lawrence Livermore National Laboratory (LLNL) hosted a workshop titled, "The Security Implications of Global Climate Change" on January 5-7, 2021, convened virtually due to the ongoing global COVID-19 pandemic. The workshop included participants from scientific/technical, defense, diplomacy, advocacy, and academic communities in the United States as well as from U.S. allies.

Discussion was guided by the following key questions:

- How will climate change impact the world in the next decade and beyond?
- How will it affect resource and human security as well as national and international security?
- How can the security effects of climate change be mitigated or managed?

Key take-aways:

1. Climate change has increased the frequency, intensity, and severity of extreme weather events. Hurricanes, for example, have become more numerous and intense, and the hurricane season has extended. Heat records have been broken in many parts of the world. Such effects can be expected to intensify in the decades ahead. What was once thought of as abnormal will increasingly become the "new normal" as changes accumulate and accelerate. Forecasts of future climate change emphasize a significant intensification of and interaction between these various effects.
    a. Failure to cap and reverse carbon loading of the atmosphere could have profound consequences for the human habitat and governance system, with the main question now being to what extent can the consequences be best mitigated.

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Capping and reversing carbon loading requires finding solutions that do not yet exist to multiple technical and political problems.

b. The impact of climate change is not being felt just in extreme weather events. Climate change is interacting with complex ecosystems in the air, at sea, and on land to disrupt the human habitat in significant ways. These interactions affect human systems as well, such as food production, access to potable water, energy supplies, transportation networks, supply chains, and governance systems (in part by eroding their political legitimacy). Climate change is also straining disaster preparedness and risk management systems at the local, national, multinational, and international leves that have all been designed around historical climate experience.

2. Climate change should be thought of as a threat multiplier, as global climate change both aggravates existing threats and generates new challenges to international security and stability. Looking to the future, these challenges can be expected to grow in scale and severity. By putting more vulnerable populations at risk, it has created new recruiting pools for violent non-state extremists. By stressing governance systems in weak states, it has led to economic collapse and criminality. By breaking down patterns of production and distribution, it has reinforced predatory economic activity by powerful and sometimes criminal outside actors. This has already generated new challenges for the U.S. military and for the larger national security enterprise.

3. The science supporting the analysis of climate change and its physical manifestations and implications has rapidly improved in recent decades with the application of more advanced monitoring and computational capabilities. The science supporting the analysis of the social and political manifestations and implications, however, is far less robust. Although work has been done to integrate the work of physical and social scientists on these questions as these collaborations have matured in recent years, more effort is needed.
    a. Mass migration has already emerged as a symptom of the disruption of the human habitat caused by climate change. Migration can be the result of the decay of economic, social, and political institutions. It may also be forced. Regardless of cause, it has disruptive effects on the country from which the emigrants are departing, the country where they are headed, and the countries along the way.
    b. Climate change is also creating new opportunities for the weaponization of resources. One good example is the weaponization of water. Water stress in many parts of the world is high and rising. Some see an opportunity for leverage by controlling access to clean, safe water. China's practice of damming the rivers flowing from its territory and then seeking political concessions from its neighbors in exchange for water flow has been criticized as a form of hydro-hegemony. Non-state actors have also weaponized water, such as when the ISIS attacked dams and other water resources in its bid to create the Islamic State.
    c. Climate change can be expected to have varied cumulative effects in the different regions of the world. One stark example is the Arctic, where warming opens up new trade routes and access to new resources. Russia has responded broadly and

assertively, especially in the military domain, driving new forms of military competition with others, including the United States and China. The Middle East, South Asia, and the Caribbean are all likely to see stark effects on natural and human systems.

4. A question remains regarding potential future roles for the U.S. Department of Defense (DoD) in a world characterized by worst-case environmental contingencies, new political agreements to undertake draconian measures, and a weak international enforcement response. In this contingency, DoD might be called upon to underwrite such enforcement, whether indirectly (e.g., by supporting an international authority in its monitoring and verification duties) or directly (e.g., by enforcing barriers to migration). The U.S. military is not well prepared for these types of contingencies.
    a. From a narrow U.S. military perspective, climate change presents various specific challenges. The U.S. basing structure, both foreign and domestic, is vulnerable to various weather extremes, especially flooding. Most of the Areas of Responsibility of the Regional Combatant Commands are seeing mission-specific consequences of warming. This helps fuel a rising debate about whether the counterterrorism and counter-insurgency operations from which the United States has long attempted to extract itself will not in fact become more demanding rather than less. There is rising interest in how to "climate proof" military hardware, systems and operations so that the military can operate in all forecast weather regimes. There is also a growing push to drive toward a zero-carbon-emission force as a national model.
    b. Over the last two decade the security consequences of global climate change have attracted rising attention in the U.S. policy community. DoD has been in the vanguard, as some of the mission impacts have been direct and immediate. But there has also been considerable reluctance in DoD to embrace needed changes in leadership focus, capability development, and mission orientation. The interagency community has put rising focus on these issues. But continued political disagreement about the science of global warming has made it difficult to accelerate the needed, sustained innovations in leadership guidance, organizational focus, funding commitments, and national culture.

5. From a broader U.S. national security perspective, climate change presents some additional challenges. Among many others, these include protection of critical infrastructure from extreme weather events (a challenge requiring strong public-private sector partnerships), improved protection against more frequent global health crises, and a rising requirement to settle national differences over immigration policy.

6. From a national strategy perspective, the central focus should be on enhancing national resilience. This is a point on which there can be broad political consensus. Such resilience requires national-level coordination of numerous require partnerships. These include federal, state, and local government entities, community-level organizations, private sector owners-operators of critical infrastructures, and key industries (e.g., insurance). It also requires focused partnerships with the generators of intellectual capital for these

challenges. Such partnerships can be built into contingency planning generated by, and implemented in coordination with, the White House.

7. From an international strategy perspective, the central focus should be on devising a viable plan for limiting to the extent possible and later reversing climate change. Improved cooperation on mitigating and managing its consequences in the security domain is at best a stop-gap effort. Such cooperation requires a holistic focus on key partnerships with governance structures, operators, and technical innovators.

8. Our international capacity to work towards these ends will be constrained by the existence of many sources of international tension and conflict, including perceptions of "winners and losers" as climate change takes place. Cooperation in the Arctic, for example, will be limited by the return of major power rivalry. Cooperation in the Middle East, as another example, will be limited by the competing political claims of moderates and extremists. These factors do not, however, preclude cooperation on some of the macro-level technical issues and other areas of shared interest. The positive experience of many nations in working at the local and national level to meet emerging challenges may yet percolate up to cooperation at the international level.

9. There are many ways to get smarter on these issues. Policymakers could make better use of scenario-based forecasting techniques to better understand emerging problems. They could study more agile systems to improve the responsiveness of government. They could do a better job of identifying and cataloguing best practices. The Intelligence Community could strengthen its scientific and technical expertise. Collaboration among physical and social scientists could be further strengthened. A great deal can be done on basic concept development. In the longer term, more needs to be done to improve overall societal interest in, and knowledge about, the solutions provided by harnessing science and technology. Towards these various ends, improved and more transparent cooperation among climate scientists can contribute a great deal to raising the overall international discourse on these matters.

10. We don't need to know more to act constructively now. "Do more, talk less" advised one workshop participant. "Stop fighting over priorities and just start acting" argued another. A third concluded that "we understand the science better now than how to work with each other." Others asserted that disputes over global warming impeded taking action in the security domain on challenges about which there is no disagreement. Still others are encouraged by the strong U.S. leadership on this agenda to which the incoming administration aspires.

Panel 1: Climate Projections 2021

- What predictions do climate models make for the coming decade and beyond?
- Are there major uncertainties? What can climate scientists say with confidence about changes in the properties of different types of extreme events?

Climate models are used to make predictions about the future climate change scenarios; in turn these scenarios form the basis for discussions of the security implications of climate change. Extreme weather events are of particular interest to national security, and climate modeling has advanced to provide reduced uncertainty in some factors affecting extreme weather events. In general, climate change will increase the severity and strength of severe weather events outside of what has historically been considered "normal." For example, it is expected that hurricanes will contain more rain, as was the case in the 2020 hurricane season in Nicaragua, and that drier atmosphere and land-surface will increase the severity of wildfires, as was seen in the 2020 Californian wildfire season. There is still uncertainty, however, in the locations and triggering conditions for future extreme weather events. Increased resolution in global storm models could improve projections in the future.

Extreme weather events are more likely to occur concurrently, both with the same location experiencing multiple extreme weather events in the same season and two different locations experiencing similar adverse weather. For example, the correlation between droughts in China and India has increased in recent years, compared to historical data. This compounding complexity gives rise to a nonlinear risk to critical infrastructure, such as disaster management, water scarcity, and food security.

Beyond extreme weather events, climate modeling has reduced the uncertainty in climate sensitivity, which describes the range of potential degrees of warming caused by a given increase in the amount of CO_2 released into the atmosphere. The wider this range, the larger the uncertainty in the climate sensitivity, and this is a fundamental aspect to be improved in climate models. A reduction in uncertainty in climate sensitivity will allow researchers to better fine tune climate change model outcomes.

The climate modeling community continues to mature from proving the existence and reality of climate change to providing insight and recommendations regarding resilience and mitigation. Data from social science describing potential policy choices and mitigation measures should be incorporated into physical modeling systems, but this will require collaborating with new disciplines and bringing in researchers to translate between disciplines. The release of archival data and large data sets generated by climate models will continue to be integral to this process

Participants called for more funding for climate change research efforts. Ultimately, the nature of climate risk, whose main impacts will affect future generations, often makes it hard to justify adequate levels of present-day funding. But recent research demonstrates the near-term consequences that the world is currently experiencing the effects of climate change in both the frequency of extreme weather events and consequent stresses to critical infrastructure. At present, the cost of mitigating current extreme weather events is far greater than the amount spent on climate change research.

Participants also spoke of new partners engaging in climate research. The research community could benefit from increased collaboration with the global community, whose diverse expertise and knowledge may improve scenario development and policy solutions for future investigation. Partnerships across different academic disciplines or new programs in higher education could also be established. Outside of the academic research community, private partners such as

insurance companies have also shown interest in climate change expertise by hiring meteorologists.

Panel 2: The Challenge of Responding to an Emergent Threat

- How will climate change aggravate existing security problems?
- What new problems will it create?
- Will impacts differ by region? If so, how?
- What frameworks exist for evaluating these risks?

Panelists divided climate change risks into two broad categories: direct and indirect. The flooding of military bases due to climate change is an example of a direct effect. Indirect effects are often secondary to a triggering event, such as social or political instability due to extreme weather events. Indirect events are more complicated because climate change often acts as a threat multiplier by exacerbating existing underlying security issues. Examples of indirect effects include the Islamic State (ISIS) targeting farmers affected by severe drought for recruitment efforts, storms in Central America leading to instability and mass migration, and warming in the Arctic.

At present, climate change is unlikely to lead to one state or region gaining significant advantage over others; however, several regional trends and disruptions could become important in the coming decades. Panelists noted that Russia may benefit from increased farmland due to increased average temperatures, but it might also experience setbacks as a major exporter of fossil fuels if the world shifts to a carbon-free economy. Russia will also deal with more contamination due to water runoff and infrastructure damage due to melting permafrost. Brazil's naval readiness could be impacted by costal erosion. Water security in the Indo-Pacific could be threatened by rising sea levels and increased tensions over dams and levees. Europe will be impacted by increased average temperatures, flooding, and wildfires, which may be exacerbated by social issues like its aging populace. Lastly, the Arctic is another region to watch, where warming is occurring 1-2 times faster than the global average. This could lead to tensions between countries with competing military and economic interests in the area.

In response to these global and regional problems, many groups of security and defense professionals have been issuing frameworks for addressing climate change. Think tanks have released global threat reports, such as the Center for Climate and Security's *A Security Threat Assessment for Climate Change*. International groups of military leaders such as the International Military Council on Climate and Security have also engaged on the issue. In the United States, the Department of Defense (DoD) has released climate assessment tools for its military installations. The National Defense Authorization Act has also called for increasing collaboration between the intelligence and federal scientific communities through a National Academies Climate Security Roundtable, which might be of interest to those in the national laboratories. Future frameworks should use data to provide more granularity in potential scenarios, identify the best indicators for tracking future trends, create systems that prioritize climate risks, and recommend specific actions and strategies across government for mitigation.

Panelists noted that the best role for DoD may not be as the primary actor but as a creator and facilitator of partnerships. Agencies like the State Department and the United States Agency for International Development (USAID) might be better positioned to offer climate change solutions. The military is skilled at adapting partnerships on the ground between combat troops and non-governmental organizations. However, aid organizations have been historically under resourced and operationally impaired compared to the DoD. Partnerships also need to be developed between professionals in physical sciences, social sciences, and national security to better evaluate climate risks. Because of the DoD's buying power, it can partner with the private sector to make climate technology, but there are issues transitioning this to the broader market- more funding for these programs would be helpful. Lastly, the DoD can project climate leadership, modeling best climate security practices for global militaries.

Several issues are important for engagement on future climate security issues. Heat stress and resource scarcity remain understudied, given the impact these issues will have across many regions. Priority should be given to pragmatic and pervasive issues, such as reducing the use of coal. In terms of leadership in government, there was recognition that while administrations that are supportive of climate change initiatives can be a game changer for funding and coordination across government agencies, climate change cannot be solved by a single leader or organization. There is a need for more training on climate change issues in military and civilian academies to build up the leadership pipeline and promote collaboration.

Panel 3: Migration and Other Disruptions to the Human Habitat

- What risk does climate change pose to water, food, and energy systems?
- How will resource instability affect social and political systems, both regionally and globally?

Climate change poses two sets of risks to water, food, and energy systems: once-rare extreme weather events will become more frequent and severe; and, baseline, normal conditions for ecosystems will change and become more volatile. Governments should prepare for what were once considered black swan events (e.g. "unprecedented," "once in a decade," "once in a millennium") to become commonplace. For example, one participant noted how Ellicott City, Maryland experienced two 1000-year floods within two years.

Not only will extreme weather events occur more frequently and with greater severity, but their effects will be compounded across multiple natural resource systems. This interconnectedness of natural systems demands a systemic view. A participant described how the 2019 "polar vortex" was preceded by extreme rain and a poor harvest and followed by an unusually wet spring that left a record area of land unplanted. Another participant argued that the concept of natural resources as individual goods like wheat or oil is outdated, and that governments should instead think in terms of ecosystems and the critical services they provide, like pollination and the provision of water.

Climate-induced resource instability affects human systems through intermediate mechanisms, with the original cause often going unrecognized. As a result, we tend to attribute social and

political phenomena to social and political causes, failing to understand the prior role of climate change. For example, the increase in northward migration from Northern Triangle countries (Guatemala, El Salvador, and Honduras) beginning in 2014 is generally attributed to the immediate trigger of violence in those countries. But that violence occurred amid larger trends of poverty and food insecurity, driven both by increasingly irregular precipitation and a warming climate that allowed the coffee rust fungus to decimate coffee crops at higher altitudes.

In general, participants focused on migration as perhaps the most important political phenomenon resulting from climate change. One participant argued that we should no longer view migration as an unnatural crisis but rather as a natural reaction to unlivable conditions. Others noted that migration and other social effects of climate change are not limited to the developing world, as evidenced by the compounded death, destruction, and displacement caused by wildfires and the COVID-19 pandemic in the United States over the last year.

Discussion also centered on how the U.S. government and scientific community can better work to understand the relationship between climate change and social phenomena. A participant argued that the U.S. national security community is structurally and doctrinally mismatched to the moment, pointing out that COVID-19 has killed more Americans than nearly any war but still is not seen as a security issue. Similarly, a foreign adversary causing equivalent destruction to the 2020 wildfires would have likely provoked a significant federal response and government restructuring. Participants offered several priorities, including emphasizing the work of agencies like National Aeronautics and Space Administration (NASA) and National Oceanic and Atmospheric Administration (NOAA) traditionally considered outside of national security, increasing discussion between social and natural scientists, and incentivizing collaboration between scientists outside of government and policymakers.

Panel 4: Weaponization of Resources

- How will states or non-state actors attempt to exploit vulnerable resources or populations?
- What implications will these have for global stability?
- Can they be stopped? By whom?

Water is by far the most common resource to be weaponized by various groups. Traditionally water and water issues have been more of an area of cooperation than conflict, but climate change is creating additional pressures on the ability to meet human and ecological demands for water. Several factors underlie water weaponization: climate change, existing animosities or rivalries, weak societal institutions or water governance, rapid changes in precipitation patterns, and unilateral construction of dams without regional or international consultation or cooperation. The risk of weaponization of water is particularly high when one state or non-state actor enjoys a hydro-hegemonic advantage over another, as is the case when upper riparian groups can control the flow of river water to those downstream.

To date, there has not been any actual weaponization or leveraging of water by state actors; however, conditions along the Nile and Mekong rivers have the potential to escalate if not

carefully managed. Ethiopia is nearing completion of the Grand Ethiopian Renaissance Dam (GERD) on the upper reaches of the Nile, which has the potential to put Ethiopia in a hydro-hegemonic position over Egypt. Egypt is already vulnerable to water stress as a result of climate change for several reasons: desert is encroaching on the fertile yet narrow Nile valley; rising sea levels are flooding and increasing the salinity of the soil in the Nile delta, Egypt's most productive agricultural region; and 96% of Egypt's water comes from outside its borders. As a result, Egypt's regime has threatened to bomb the GERD if construction continues, but so far conflict has been limited to bellicose rhetoric.

A somewhat similar situation exits in Southeast Asia along the Mekong river, where China has constructed eleven mega-dams which hold back 47 billion cubic meters of water and control up to 40% of the Mekong's flow. Furthermore, Laotian and Burmese dams along the Mekong are primarily financed by China, giving the country even greater potential leverage over Southeast Asian counties. While it seems unlikely that China has a documented policy of using their control over the Mekong river flow and financial power over Mekong infrastructure development as leverage over the lower riparian countries, particularly Vietnam, they are in a situation to exert pressure if they so desired.

While water weaponization has not occurred at the state level, there have been a number of cases of weaponization at the sub-state level, primarily conducted by extremist groups. In the ongoing Syrian civil war, ISIS has used water weaponization to fuel its rise: they were responsible for twenty-one of the forty-six recorded water weaponization incidents in Syria and Iraq. Notably, in 2014 they took control of the Mosul dam upstream from Baghdad and American assets which gave ISIS virtual control over a large swathe of territory in Northern Iraq. Had they destroyed the dam, a wall of water ten feet high would have been unleashed on areas south of the dam. This event in particular precipitated United States air strikes and greater involvement in the region.

Groups other than ISIS have also used water scarcity to further their strategic aims. In Somalia, Al Shabaab has tried to deny food assistance to locals and prevent international observers and aid during a drought related famine, which resulted in them achieving some level of increased recruitment. They also diverted the Jubba river during a conflict with an American special forces' operations team, causing minor casualties and forcing the Americans to tactically relocate.

To address water weaponization, panelists emphasized utilizing three levels of American foreign policy: defense, development, and diplomacy. From a defense perspective, military and government decision makers should apply an understanding of sub-national actors use of water as a weapon into counter-insurgency strategies. From a development perspective, policy makers should provide development assistance to help increase the capacity of states to provide water infrastructure and services that would lessen the potential radicalization of local populations. Investment in the construction and restoration of water infrastructure in post-conflict stabilization programs should also be a priority. On the diplomatic level, the policy makers should seek to support the application and enforcement of international laws pertaining to the use of environment as a weapon such as the Environmental Modification Convention (ENMOD) which prohibits the hostile use of environmental modification techniques, and the Geneva Convention Protocol II which prohibits the intentional destruction of water infrastructure.

Other approaches to mitigating the risk of water weaponization could include supporting legal and institutional arrangements to resolve water disputes and advance cooperative management of shared waters. Satellite imagery, remote sensing data, and hydrological modeling tools have also been useful in communicating water issues and creating a shared understanding of water risks. The latter suggestion proved successful in 2018 when rainfall and streamflow forecasts provided by the United States successfully calmed tensions between Egypt and Ethiopia. Finally, it is crucial that multidisciplinary science is translated into effective national security policy making. Doing so will require that the gap between scientists and the policy world be bridged. Some potential methods of achieving this goal include making an effort to bring more scientists into government and creating organizations that facilitate increased communication and coordination between the scientists and the government.

Panel 5: Competition over the Arctic

- Which states have strategic interests in the Arctic?
- What new sources of competition will emerge due to changes in the Arctic climate and geography?
- How can this competition be managed?

The rapid and dramatic melting of Arctic sea ice presents a potential "geostrategic earthquake" that will be felt by many countries. Eight countries touch the Arctic: Norway, Sweden, Finland, Russia, the United States, Canada, Denmark, and Iceland. Significant changes in sea ice coverage by 2050, and potentially as early as 2030, could lead to the opening of new sea routes, including the Northern Sea Route, Transpolar Route, and the Northwest Passage. These new routes would connect 75% of the world's population, expanding the number of nations with interests and creating more competition. There are still unresolved legal issues regarding the Northwest Passage and Northern Sea Route, which will need to be addressed to maintain cooperation.

Many countries who are not connected to the Arctic geographically also have growing interests in the region, specifically China. China has claimed that they are a "near-Arctic" state and therefore have a scientific right to the region. China's long-term strategy focuses on increasing their economic and scientific influence. Despite Beijing's status under the United Nation's Convention on the Law of the Seas, they are still managing to challenge the current Arctic governance. China has also increased their ties with Russia due to China's investment in Russia's oil and gas industries; this could result in a two-front conflict for the United States by China not competing with Russia in the same area.

Russia has also been putting a large amount of emphasis on the Arctic region as part of their long-term strategy. When the ice fully melts, this opens another operational front and leaves it susceptible to NATO encirclement. A large part of Russia's nuclear deterrent capability is also near the Arctic region. Their military buildup is part of their long-term strategy to maintain and defend their economic interests and their sovereignty, which presents challenges for Western nations, specifically NATO.

In order to counter the growing presence of Russia and China in the region, the panelists highlighted the need for NATO's continued presence and for increased cooperation and exercises among NATO members and with non-NATO partners like Sweden and Finland. There is concern over surprise and ambiguity in peacetime, and the panelists urged NATO to be predictable and transparent to help prevent accidental escalation.

The United States has also started to put more emphasis on the Arctic region through their new Air Force Arctic strategy and Navy Arctic strategy. However, the United States still runs into the question of whether to keep the status quo or to prevent a "dominant" Russia or China in the region. To help with these, the United States needs to work through NATO and prevent a two-front conflict with Russia and China.

To manage this competition, European and Arctic states should be included in any dialogue on a long-term basis. This includes reforming confidence building measures and engaging Russia in discussions. There also needs to be an Arctic military and political meeting at a high level to possibly look into creating an Arctic Ocean security forum. In the medium-term, NATO must bring Russia into talks and try to keep China out of the Arctic. The United Nations can play an important role by being neutral governance in the region. The actors need to be looking at short-term situations and long-term trends to figure out how to create meaningful cooperation going forward.

Overall, Arctic states have a pragmatic view and have been able to cooperate well in the past. It has been fairly easy to get agreements at the Arctic Council, but the harder security issues need to be addressed going forward. It's hard to say if the Arctic will be a place of competition or cooperation, but the long-term strategy must focus on cooperation and common issues.

Panel 6: Scoping the Needed Military Technical Responses

- What adaptions to U.S. military strategy, operational planning, and capability development are warranted?
- What can and should other U.S. departments and entities contribute to the needed whole of government approach?
- Where should technology developers focus?

This panel focused on the readiness of the DoD and its intragovernmental partners to address the ramifications of climate change. The panelists argued that competition for resources within the budget and politicization inhibit DoD effectiveness on climate change. To move past these issues, the DoD should focus on interagency collaboration, public-private collaborations, and operator-centric planning. Currently, short-term planning budget constraints from managing legacy equipment, modernization, and troop sustainment eclipse the longer-term thinking required to counteract climate change. The continuing resolution budget process encourages rush approvals and line-item requests in a department full of inter-service resource competition. Furthermore, combatant commands are largely responsible for mission planning, often occurring on short notice, which further strengthens the immediate concerns-nature of resources. As one panelist emphasized, allocating scarce budget money for climate change

resources ten years away will never succeed if competing against present needs and operations. The key is to maximize versatility and robustness of future systems to ensure operators can carry out missions in any type of changing environment or conditions. Budget requests, therefore, should consist of universally beneficial systems instead of static, singular mission ones.

While procurement, especially of green technologies or sustainable solutions for climate change mitigation, is an important power the DoD could leverage, the panel cautioned against a strictly technology-focused approach. The parameters of a problem, given the dynamic shift in climate in recent years, can change significantly during lag between development and deployment of a technical solution. One solution is to increase investments in science and scientific research, rather than just technology. Military technology and strategy cannot advance without the underlying science and frameworks bolstering its effectiveness. Transitioning from theory and concepts to operational applications for military technology development is crucial.

Interagency efforts are also required to adapt a United States-forward approach on climate change. For protecting bases in Alaska, for example, a receding ice barrier causes increased risk of uncontrolled borders. While the DoD can protect the grounds of the base, it is not fully responsible or able to patrol the borders on its own; therefore, Department of Homeland Security (DHS) must be involved. Situations like this will grow increasingly common as issues like water insecurity, drought, fires, and more affect the immediate areas surrounding U.S. installations and efforts worldwide. Other government entities like the State Department will be vital partners in these endeavors, especially on the diplomatic front where climate change treaties or coordination with allies are involved. Different facets of climate change will have different effects on the various agencies and their domains, potentially impeding said entity's mission. For this reason, communicating across government to exchange data and coordinate joint responses is the best path forward.

Lastly, the panelists agreed that public-private collaborations and implementations of best practices are the key drivers for military readiness against a changing environment. It is unnecessary to build new military technology systems; instead, the military should take the legacy approach and adapt the systems already in use to the necessary specifications and capabilities required for engaging in any affected environment. However, steps to increase trust with the private sector must be taken before engaging in any adaptation discussions. Substantial communication and collaboration on core mission planning and readiness will help the military end its trend of purchasing unnecessary systems. Instead, developers can approach the military with improvements to systems it knows the military will use and benefit from. In general, a back-to-basics approach focused on analysis of past successes and failures will be vital to future public-private relationships.

Panel 7: Managing Climate Change Amidst Strategic Rivalry

- How will climate change affect great power rivalry?
- Will climate change create new sources of competition and/or cooperation?
- How can this competition be managed and cooperation improved?

The intersection of climate change and strategic rivalry is a two-way street: climate change will affect and potentially exacerbate great power rivalries, and great power rivalries will impact countries' abilities to respond to intrastate, interstate, and international climate change. As an example of one side of this dilemma, climate change in the Middle East led to a rise in the price of wheat, which destabilized the region and led to interventions and collisions between multiple great power actors. On the other hand, the growing strategic competition between China and the U.S. has lead to less cooperation between the two on climate change issues.

Several examples were discussed in which climate change is currently or likely will in the future exacerbate pre-existing regional rivalries, potentially leading to more extreme socioeconomic impacts. One example shared was the power balance between India, Pakistan, and China. All three are nuclear powers, India and Pakistan have long standing conflicts, and China occupies disputed territory along its border with India. Climate change will overlay environmental and natural resource constraints in the form of an increased number and severity of droughts and heat waves, and reduced flows in the rivers that traditionally serve as the primary source of water in India. The secondary water source for this region comes from Himalayan runoff. The majority of which runs through Chinese controlled territories and could be constrained or diverted, adding additional stress to an already precarious balance. While the physical and environmental changes in this region can be estimated with reasonable certainty, how those changes will influence or exacerbate relations between rival neighbors is much less conclusive.

This example highlights the importance of interpreting the physical and environmental aspects of climate change in socio-economic and geo-political terms. Global warming metrics are not meaningful beyond the climate science community unless we can communicate what they mean in terms of factors such as food and water scarcity. The panelists advocated for robust collaboration between physical climate scientists and the social scientists who are better able to interpret the human impacts of climate change. This type of collaboration will provide critical inputs to national governments and the international community as they respond to the impending changes that will be driven by climate change.

It is unclear how the international community can or will mobilize to address climate change. There is currently no international organization capable of addressing climate change in a way that could mitigate the more extreme impacts that will ultimately affect power balances. Opportunities do exist for collaboration, including among traditional rivals. As with other science focused collaborations, the EU and China have been able to cooperate on greenhouse gas emission reductions. Both parties understand that cooperation is a critical piece to addressing climate change. They remain strategic competitors while also working together to implement critical emissions reductions. It has however become clear that climate is no longer a standalone issue and must be considered as an integrated aspect that cuts across all strategic interests.

In addition to global coordinated responses, the panelists emphasized the role played by private sector actors in spurring and strengthening climate change responsiveness and global competitiveness. Two examples in which the private sector can influence the United States' climate change posture both domestically and internationally were discussed. The first example considered the influence financial institutions can have when considering investments in private sector companies. When climate change exposure is as a factor that is considered when assessing a company's risk exposure and suitability for investment, those companies will prioritize addressing their own exposure to climate change risk. The second example discussed

involved strategic investment in U.S. technologies related to mitigating, adapting to, or otherwise addressing the impacts of climate change. The benefits of this kind of investment are multifold and include supporting U.S. technology and the companies that develop it, reducing our domestic climate footprint and increasing our climate resilience. Globally, it could also provide an alternative to technology developed and exported by strategic rivals. Since the 1990s U.S. influence has been declining in this area while China's has been increasing. It was estimated that in 2018 China was responsible for over 40% of renewable energy exports globally. Strategic investment in U.S. technologies in this area will increase U.S. influence without direct confrontation with our strategic rivals.

Panel 8: Building the Needed New Partnerships for Resilience

- What partnerships already exist at the national, international, multinational, and public-private levels? Which are functioning well? Poorly? Why?
- What new partnerships are needed?

This panel evaluated the partnerships that address climate security and resilience in the U.S. and abroad. Panelists highlighted the importance of domestic resilience as a national security priority, which is determined by the culmination of partnerships in all relevant areas of vulnerability. The primary challenge is not creating new partnerships but better coordinating and effectively collaborating between existing partnerships and organizations. Comprehensive risk management is more complex than ever due to increasingly overlapping threats and a disproportionate focus on black swan events.

Partnerships for climate resilience are generally divided into four areas: the individual-community level, public-private relationships, federal-state levels, and international initiatives. The 2020 COVID-19 pandemic demonstrated how deficiencies across sectors in the supply chain exacerbated challenges in communications, energy, and healthcare across the United States. Critical infrastructure protection is inherently a public-private partnership challenge that should be bolstered to enhance domestic resilience. All pillars of partnerships experience challenges in information sharing, both vertically and horizontally across organizations. If information is not readily available, then national resources are ineffective. But panelists stressed that having more information is not directly translated into having more knowledge, and successful partnerships should work towards understanding which information is critical for increasing resilience.

To build resilience at a local level, communities must understand the existing resources and assistance programs to form the necessary collaborations. Channeling resources effectively is a key concern for domestic stakeholders. Among the various U.S. Government agencies, the Federal Emergency Management Agency (FEMA), the Department of Energy (DOE), and the U.S. Army Core of Engineers have dedicated programs and resources could be used to increase resilience in local communities. FEMA's Building Resilient Infrastructure and Communities (BRIC) initiative allocates 250 million dollars in annual pre-disaster hazard mitigation grants, but they are not used by all states. Another encouraging practice happens at the regional level, where some hurricane-prone states such as Florida, Texas, and Louisiana have started collaborating to share lessons learned and best practices. These efforts are largely piecemeal but could provide a

useful framework for expanding coordination and promoting resilience. Panelists recommended a more centralized database that could provide a "library of tools" for all stakeholders.

At the international level, several multinational and private-public partnerships exist to improve climate resilience. Initiatives like the C40 Cities Climate Leadership Group show how a bottom-up approach can build meaningful strategies and shared goals between actors. The Alliance for a Climate Resilient Earth (ACRE) is a new international initiative with over 100 members since its inception in 2020. ACRE aims to facilitate information sharing and stronger partnerships between public and private actors. Ongoing challenges, such as the melting of Arctic ice, will require cooperation to safeguard domestic resilience. International collaboration is essential to avoid the worst consequences.

To build resilience, the U.S. should focus primarily on reducing the impact of climate related events, preventing lasting damage, and adapting for new challenges. To do this, stakeholders should create actionable plans that are regularly practiced, integrated between partnerships, and informed by case studies and collective learning. Panelists recommended that the next U.S. national security strategy highlight the protection and resiliency of critical infrastructure as a central element needed to accelerate existing partnerships. More granularity and communication at the local level will help strengthen partnerships from the bottom-up, but the role of international initiatives should not be ignored. While progress is often cyclical and episodic, sharing more information between local, state, and federal entities will help form the needed resilience for unanticipated climate events.

Closing Observations

Across the various panels, five themes emerged. First, while progress has been made in improving climate modeling and gathering more data from abnormal climate events, climate change remains a challenging issue to scope. On the whole, climate change is a problem that is likely to get worse because solutions remain elusive and their development runs contrary to how the world currently operates. Historical data and trends are not sufficient for future projections needed to create resilience. New and better data are being collected to improve understanding of climate change from a physical and social perspective. But it is still a challenge to identify the data that would be most persuasive or useful for making specific policy decisions. Similarly, broad frameworks exist for addressing climate change risks, and new frameworks for climate action are emerging. Policymakers should also be willing to learn from case studies or successful examples when designing future climate mitigation strategies.

Second, climate change will likely lead to unanticipated challenges, by serving as a multiplier for existing threats or by changing the relationships between states. For example, ISIS recruitment efforts targeted farmers affected by drought and sought control over strategic water resources to gain power during the Syrian civil war. Elsewhere, climate change, either through drought or extreme weather events, has led to poor agricultural yields in Latin and South America. Those experiencing this loss are more susceptible to social and political insecurity and therefore more likely to migrate. Climate change may also lead to new forms of competition between states or afford others new advantages. The U.S., Russia, European Union, and China all have commercial

and military interests in the Arctic, which are bound to be affected by the continued sea ice melting in the region. Russia may have an increased role in global agriculture. China may also look to exert more control over water in the Mekong River Delta. That being said, many of these countries will also face setbacks due to climate change and may not be in a position to use these to strategic advantage.

Third, many of the challenges due to climate change will require cross-disciplinary solutions. Research in physical and social impacts of climate change must be combined to give better information to policymakers and drive new research. Some examples of this type of work are emerging across government, think tanks, and academia, but there is a need for more expertise and programs to train the next generation of researchers. Participants in academia and government spoke about needing specific experts working at the interfaces or translators between different groups to provide these solutions.

Fourth, the challenges posed by climate change may require incorporating additional frameworks outside of security, such as resiliency and development. For example, while the U.S. DoD will remain a stakeholder in climate change efforts, especially in emergency or peacekeeping missions, other agencies in the U.S. government could be better suited to address civilian needs. Specifically, the State Department and U.S. Agency for International Development might be better positioned to take a leading role. Local partners, including state and tribal governments, are also crucial to the success of climate change mitigation efforts. In these cases, the DoD could serve as a facilitator, leveraging its existing partnerships across the globe.

Fifth, these partnerships are crucial to creating resiliency against current and future adverse effects of climate change. From the ground up, there are four types of partnerships that should be strengthened: collaborations between the individual and community, public and private enterprise, states and national government, and the U.S. and global actors. Finding key players who can bridge these divides is crucial. For example, those working to engage private companies on sustainable development goals laid out by the United Nations found that companies were highly motivated by the advice of investors and insurers. Across the board, people want action plans for climate change. There have been some cases where plans have been developed and implemented; these should serve as examples and important lessons moving forward.

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