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The Complex Relationship Between Militaries and Global Catastrophic Risk

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Dedicated to Cora Fogle, the noticer, protector, and guardian of small and vulnerable things. Her compassion for endangered life inspires the urgency behind this work.

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About GCRI

The Global Catastrophic Risk Institute (GCRI) is a nonprofit, nonpartisan think tank. GCRI works on the risk of events that could significantly harm or even destroy human civilization at the global scale. As a think tank, GCRI bridges the world of scholarship and the world of professional practice in government, private industry, and other sectors. It aims to develop highly effective solutions for reducing the risk by leveraging both the best available scholarship and the demands of real-world decision-making.

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Abstract

Global catastrophic risk (GCR) is heavily affected by the institutions that people organize into, but these effects have not been systematically studied. This paper presents a scoping review mapping out the effects on GCR of one of the most important human institutions, the military. Militaries are widely recognized as central actors in certain global catastrophe scenarios like nuclear war, but this captures only a small portion of the overall relationship between militaries and GCR. The paper identifies five core dimensions of the relationship between militaries and GCR: acts of violence, technology research, environmental impact, outer space, and catastrophe management. The paper finds that while militaries can create and enable certain GCRs, militaries also play important roles in GCR reduction. Policy recommendations focus on the ways militaries could play an expanded role in GCR reduction.

1. Introduction

This paper presents a survey of how militaries can affect global catastrophic risk (GCR), cutting across the entire spectrum of GCRs. The paper aims to provide guidance for people involved in military affairs and a starting point for more targeted scholarship on the roles of militaries in GCR.

Because militaries are charged with the use of large-scale violent force, one might expect them to have a generally harmful effect on GCR, such as by waging nuclear war or building advanced weapons powered by artificial intelligence.[1] In that case, efforts to reduce GCR may need to focus on how to keep militaries in check. However, as this paper documents, the full range of effects of militaries on GCR is more complex than that. Some military activity may increase GCR, whereas other activity may decrease it. Likewise, to reduce GCR, in some instances it may be necessary to keep militaries in check to prevent them from increasing GCR, whereas in other instances it may be helpful to empower militaries, or to empower certain initiatives within militaries, so that they can reduce GCR. The paper aims to map out this more nuanced and complex relationship between militaries and GCR.

The paper focuses on militaries due to their potential to have a large effect on GCR. Some anecdotes can illustrate this. First, militaries tend to be large and well-resourced institutions: in 2023, world military expenditures were $2.44 trillion with the United States military alone spending $905.5 billion,[2] and at least ten countries have more than 500,000 serving personnel.[3] Second, militaries have distinctive operational capabilities: the US Army claims to possess more vehicles than United Parcel Services and FedEx combined.[4] Third, militaries have been very active in attending to extreme risk scenarios, as seen for example in the development of self-sustainable bunkers designed to survive the possibility of nuclear conflict, such as the Raven Rock Mountain Complex, the Cheyenne Mountain Complex, and the Mount Weather Emergency Operations Center.[5] Fourth, and perhaps most obviously, militaries often have operational control over weapons of incredible destructive power – especially nuclear weapons and their means of delivery – which means that militaries would play a major role in causing global catastrophes under several scenarios. It is due to factors such as these that militaries are important for GCR research to study.

For purposes of this paper, GCR can be defined broadly as the risk of events that would cause severe harm to humanity on a global scale, such as the collapse of civilization or the extinction of the human species.[6] GCR is at the extreme end of low-probability, high-severity risks. A global catastrophe would be tragic for everyone alive at the time of the event and could also substantially worsen or even

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[1] See e.g. Matthijs Maas, Kayla Lucero-Matteucci, and Di Cooke, "10. Military Artificial Intelligence as a Contributor to Global Catastrophic Risk," in *The Era of Global Risk*, 1st ed., edited by SJ Beard, Martin Rees, Catherine Richards, and Clarissa Rios Rojas (Open Book Publishers, 2023), https://doi.org/10.11647/OBP.0336.10; Dan Hendrycks, Mantas Mazeika, and Thomas Woodside, "An Overview of Catastrophic AI Risks," arXiv:2306.12001 (2023), https://doi.org/10.48550/arXiv.2306.12001.

[2] Michael E. O'Hanlon and Alejandra Rocha, "What's in Biden's $850-Billion Defense Budget Proposal?," *Brookings Institution* (15 March 2024), https://www.brookings.edu/articles/whats-in-bidens-850-billion-defense-budget-proposal; Tian Nan, et al., "Trends in World Military Expenditure, 2023," *SIPRI* (April 2024), https://www.sipri.org/sites/default/files/2024-04/2404_fs_milex_2023.pdf.

[3] International Institute for Strategic Studies, *The Military Balance 2025* (Routledge, 2025).

[4] J. D. Leipold, "Is the Army a Business?" *US Army* (30 May 2014), https://www.army.mil/article/126882/is_the_army_a_business.

[5] The civilian Federal Emergency Management Agency is currently responsible for the Mount Weather complex; however, the facility was originally built by the Army Corps of Engineers.

[6] A variety of more specific definitions of GCR have been proposed; for examples, see e.g. Section 2.2 of Seth D. Baum, "Climate Change, Uncertainty, and Global Catastrophic Risk," *Futures* 162 (September 2024), 103432, https://doi.org/10.1016/j.futures.2024.103432.

eliminate prospects for future generations. The stakes are exceedingly high, and so, if risk is quantified as the product of probability and consequence, GCR may be a large risk even if the probability is quite low. For this reason, a case can be made for the importance of reducing GCR.[7]

Advancing the reduction of GCR benefits from an understanding of how different human actors can affect GCR. Therefore, it is important for GCR research to consider the people and institutions that could affect GCR. We wish to emphasize the importance of institutions such as the military. Institutions like militaries can have a very large effect on GCR. They are also a primary focus of policy-making (e.g., military policy), professional activity (e.g., many people have careers in military affairs), and social organization (e.g., people involved in military affairs interact extensively with each other, both for their work and through the social communities that emerge adjacent to their work). For these reasons, there is value to an institution-centric study of GCR, with militaries being a notable category of institution.

For purposes of the paper, militaries can be defined as states' organized armed forces for projecting power and enabling national defense. This includes active military services and supporting institutions that enable the use of organized armed force, such as national command authorities, defense industrial bases, weapons research laboratories, and military intelligence agencies. We distinguish between a country's military and its political command authority. For example, the United States (US) President has a role in military affairs as Commander in Chief, but the President also has many other responsibilities. In some cases, the distinction between military and political command is blurry, such as in states run by a military junta. Our focus is on the military as the apparatus that implements the national security policies created by national leaders, irrespective of whether these leaders wear a uniform or not.

Our interest in this paper is in mapping out the full range of effects that militaries can have on GCR. To that end, we present in this paper a scoping review of this topic. A scoping review is a type of systematic literature review that provides a broad overview of a topic. Scoping reviews map out the overall scope of the topic, its primary themes, and relevant literature. Scoping reviews are especially appropriate for broad topics in which there has been prior research on some aspects of the topic but less work pulling it all together.[8] That is the case for the effects of militaries on GCR: there has been research on some aspects, such as nuclear war, but no prior work mapping out the full range of effects that militaries can have on GCR.

The paper's review consists of a targeted literature review and synthesis across various potential effects of militaries on GCR. The literature review covers scholarly work across multiple disciplines (e.g., international security, science and technology studies, disaster risk management) and relevant grey literature (e.g., government and alliance doctrine, strategy and technical assessments). Sources were identified through comprehensive searches and feedback through highly cited and policy-salient references, with inclusion guided by whether a source described a plausible pathway by which military institutions could materially increase or decrease GCR. This approach prioritizes breadth and conceptual coverage over detailed scenario analysis or quantitative estimation of effects on the risk.

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[7] Seth D. Baum, et al., "Long-Term Trajectories of Human Civilization," *Foresight* 21, no. 1 (2019), 53–83, https://doi.org/10.1108/FS-04-2018-0037; Elizabeth E. Cameron, "Emerging and Converging Global Catastrophic Biological Risks," *Health Security* 15, no. 4 (2017), 337–38, https://doi.org/10.1089/hs.2017.0043; Owen Cotton-Barratt, "Global Catastrophic Risks," *Global Challenges Foundation*, 2016, https://globalchallenges.org/app/uploads/2023/06/Global-Catastrophic-Risks-2016.pdf; Cass R. Sunstein, "The Catastrophic Harm Precautionary Principle," *Issues in Legal Scholarship* 6 (2007), 3, https://doi.org/10.2202/1539-8323.1091.

[8] Susanne Mak and Aliki Thomas, "Steps for Conducting a Scoping Review," *Journal of Graduate Medical Education* 14, no. 5 (2022), 565–67, https://doi.org/10.4300/JGME-D-22-00621.1.

To organize this mapping exercise, we developed a five-part categorization scheme covering the principal ways militaries interface with GCR. We developed the scheme from our interpretation of the literature and our own prior understanding of the topic. The five categories of the scheme also serve to organize the paper:

- **Acts of violence** (Section 2): wars, counterterrorism, and other activities that inflict harm on opponents.
- **Technology research and development** (Section 3): support for or other involvement in the process of studying and developing new offensive and defensive technologies.
- **Environmental impacts** (Section 4): environmental protection and activities that may harm the environment, whether intentional or inadvertent.
- **Outer space** (Section 5): any activity involving outer space, whether to project force or for other purposes.
- **Catastrophe management** (Section 6): preparation for, response to, and recovery from a catastrophic incident.

These categories are not mutually exclusive: many military activities span multiple categories. Nonetheless, they provide a practical framing for a cross-risk survey while keeping the analysis anchored in concrete institutional functions.

Section 7 presents overarching trends along two dimensions: (1) militaries as a driver of GCR, causing an increase in the risk, vs. as a mitigator of GCR, causing a decrease in the risk, and (2) militaries having direct effect on GCR vs. militaries having an indirect effect on GCR by influencing other actors. Section 8 concludes.

Several cross-cutting themes emerged from this study:

- Militaries touch many aspects of GCR, including important impacts on aspects that might not traditionally be considered the domain of the military, such as climate change.
- Great power militaries like those of the United States, Russia, and China are likely to have disproportionately large effects (positive and negative) on GCR compared to smaller militaries.
- Militaries can function as both drivers of GCR (causing an increase in the risk) and mitigators (causing a decrease in the risk).
- The effect of militaries on GCR will vary, sometimes extensively, across different global catastrophe scenarios. For example, militaries may be a key driver in nuclear war scenarios and a key mitigator in societal collapse scenarios.
- Militaries are not independent actors, but instead are embedded in global societies, and likewise, their decisions and actions shape and are shaped by larger systemic contexts.

Throughout the paper, there is some emphasis on the US military. This is due to the authors' particular expertise and because the US military is of outsized importance. However, many of the insights also extend to the militaries of other countries.

The paper contributes to the literatures on both military affairs and GCR. Prior studies have considered the role of militaries in specific GCRs such as nuclear war[9] and climate change;[10] to this

[9] James Scouras, "Nuclear War as a Global Catastrophic Risk," *Journal of Benefit-Cost Analysis* 10, no. 2 (July 2019), 274–95, https://doi.org/10.1017/bca.2019.16; Matthew Rendall, "Nuclear War as a Predictable Surprise," *Global Policy* 13, no. 5 (2022), 782–91, https://doi.org/10.1111/1758-5899.13142.

[10] CNA Military Advisory Board, "National Security and the Accelerating Risks of Climate Change," *CNA Corporation* (8

literature, the paper contributes a more holistic perspective through a cross-risk survey.[11] Additionally, as a more general contribution to the GCR research literature, the paper contributes an institution-centric approach to the existing cross-risk approach to studying GCR. Prior research on GCR has occasionally, but not often, taken a primarily cross-risk approach.[12] Yet, scholars have also argued for considering GCR from the perspective of those who would reduce it,[13] and studied how a variety of actors could affect a specific GCR.[14] We are unaware of any prior GCR research that presents the combination of cross-risk and institution-centric approaches presented here.

2. Acts of Violence

Militaries are responsible for executing many national policy decisions regarding violence, including war and other forms of defense of national interests. The decisions by military leaders and individual soldiers can thus have significant impacts on how such violence unfolds. Acts of violence have four GCR-related dimensions: direct application of force, conflict escalation, side effects of violence, and violence to reduce risks.

2.1 Direct Application of Military Force

Nuclear war is perhaps the most obvious GCR involving militaries. The militaries possessing large nuclear arsenals have the potential to cause extreme global harm. However, the role of militaries is limited due to them typically not having the authority to launch nuclear weapons; instead, the authority is typically held by political leadership, which makes decisions about whether to launch nuclear weapons, how many, at what targets, etc. Military personnel can sometimes play a role in advising political command on these decisions: the role of the Joint Chiefs of Staff, for example, the highest ranking military officials in the US military, is to advise the president on military affairs. They are also responsible for executing launch decisions, and may suggest consultations, changes, or possibly (though unlikely) outright refusal to execute if the decisions conflict with laws of armed conflict and the Uniform Military Code of Justice.[15]

March 2014), https://www.cna.org/analyses/2014/national-security-and-the-accelerating-risks-of-climate-change.

[11] We also wish to acknowledge research by Nathan Alexander Sears, "Existential Security: Towards a Security Framework for the Survival of Humanity," *Global Policy* 11, no. 2 (2020), 255-66, and Noah B. Taylor, *Existential Risks in Peace and Conflict Studies* (Palgrave Macmillan, 2023), arguing to include GCR within the fields of security studies and peace and conflict resolution.

[12] Seth D. Baum and Anthony M. Barrett, "Towards an Integrated Assessment of Global Catastrophic Risk," in *Proceedings of the First Colloquium on Catastrophic and Existential Risk*, edited by B.J. Garrick (Garrick Institute for the Risk Sciences, University of California, Los Angeles, 2017); Tom Cernev and Richard Fenner, "The Importance of Achieving Foundational Sustainable Development Goals in Reducing Global Risk," *Futures* 115 (2020), 102492, https://doi.org/10.1016/j.futures.2019.102492; Rumtin Sepasspour, "All-Hazards Policy for Global Catastrophic Risk," *Global Catastrophic Risk Institute Technical Report 23-1* (2 November 2023), https://gcri.org/publications/research/all-hazards-policy.

[13] Seth D. Baum, "The Far Future Argument for Confronting Catastrophic Threats to Humanity: Practical Significance and Alternatives," *Futures* 72 (2015), 86–96, https://doi.org/10.1016/j.futures.2015.03.001.

[14] Seth D. Baum, "Confronting the Threat of Nuclear Winter," *Futures* 72 (2015), 69–79, https://doi.org/10.1016/j.futures.2015.03.004; Peter Cihon, Jonas Schuett, and Seth D. Baum, "Corporate Governance of Artificial Intelligence in the Public Interest," *Information* 12, no. 7 (5 July 2021), 275, https://doi.org/10.3390/info12070275.

[15] Anya L. Fink, "Authority to Launch Nuclear Forces," *Congressional Research Service* (19 December 2024), https://sgp.fas.org/crs/natsec/IF10521.pdf.

Although the bulk of the responsibility for nuclear war decisions generally rests with political leadership, circumstances exist in which decisions to launch nuclear weapons can be delegated to or subsumed by military personnel. In some warfighting scenarios, the political command authority has already been killed, or it has lost the ability to communicate with the relevant portions of the military. Under these circumstances, political leadership may have delegated launch authority to commanders in the field. For example, in 1962, during the Cuban missile crisis, a Soviet submarine lost contact with Moscow and was under duress from US depth charges. The military personnel on the submarine debated launching a nuclear torpedo. The historical record is unclear on how close they came to launch or if they were even able to do so without direct orders from Moscow,[16] but the incident nonetheless illustrates the type of scenario in which military personnel may be more directly involved in nuclear launch decisions.

Global catastrophe may also be possible via military force using other weapons. Among existing classes of weaponry, the one with the greatest potential to cause global catastrophe is contagious biological weapons.[17] Fortunately, militaries generally avoid these weapons due to the general taboo on biological weapons and the difficulty of avoiding harm on one's own population as a contagion spreads widely. Future technologies could potentially lead to new forms of weapons that pose a GCR.

2.2 Conflict Escalation Dynamics

Military activities can substantially affect escalation dynamics, thereby affecting political decisions about large-scale conventional or nuclear war. For instance, poor battlefield performance can back political leaders into a strategic corner, increasing escalation risks. This has been a substantial concern during the 2022 Russian invasion of Ukraine, specifically the notion that poor Russian battlefield performance could cause leadership to escalate to nuclear war.[18] Other military activities can also affect escalation. For example, in the famous 1983 Petrov incident, Soviet military officer Stanislav Petrov declined to report a nuclear alarm to his superiors, which turned out to be a false alarm. Soviet leadership would not necessarily have ordered a nuclear launch if the alarm was reported, but Petrov's action precluded this possibility.[19]

Nuclear deterrence is rooted in the possibility of devastating retaliation to an initial nuclear attack, making the initial attack undesirable. If a country can avoid retaliation, that could make the initial attack more likely. Militaries play a substantial role in this. For example, militaries can develop survivable command and control systems to ensure a state can respond with nuclear force in the event of an attack; if an adversary did not consider its opponent to have a viable "second strike capability," this would create an incentive for the adversary to strike first.[20] Additionally, militaries may develop

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[16] Svetlana V. Savranskaya, "New Sources on the Role of Soviet Submarines in the Cuban Missile Crisis," *Journal of Strategic Studies* 28, no. 2 (2005), 233–59, https://doi.org/10.1080/01402390500088312.

[17] Seth D. Baum, "Winter-Safe Deterrence: The Risk of Nuclear Winter and Its Challenge to Deterrence," *Contemporary Security Policy* 36, no. 1 (2015), 123–48, https://doi.org/10.1080/13523260.2015.1012346.

[18] Francesca Giovannini, "A Hurting Stalemate? The Risks of Nuclear Weapons Use in the Ukraine Crisis," *Bulletin of the Atomic Scientists* (2 March 2022), https://thebulletin.org/2022/03/a-hurting-stalemate-the-risks-of-nuclear-weapon-use-in-the-ukraine-crisis.

[19] David Hoffman, "'I had a Funny Feeling in my Gut'," *Washington Post* (9 February 1999), https://www.washingtonpost.com/archive/politics/1999/02/10/i-had-a-funny-feeling-in-my-gut/97fb4af6-2a54-4805-8ec0-115a13f33493.

[20] Desmond Ball, "Can Nuclear War Be Controlled?: Introduction," *The Adelphi Papers* 21, no. 169 (1981), 1–2, https://doi.org/10.1080/05679328108457385; "Air Force Doctrine Publication 3-72: Nuclear Operations," *U.S. Air Force Doctrine Publication 3-72* (18 December 2020), https://www.doctrine.af.mil/Portals/61/documents/AFDP_3-72/3-72-AFDP-NUCLEAR-OPS.pdf.

new technologies that make it more difficult for adversaries to retain retaliatory capabilities.[21] For example, machine learning technology can be applied to locate adversary missiles and command and control sites, making it easier to destroy these facilities in an initial attack.[22]

Alliances are key mechanisms by which states can combine their capabilities to inflict violence and signal their resolve to do so, making alliances (especially those that have a nuclear weapons element) a key element in the strategic aspects of conflict escalation, de-escalation and prevention. Although the choice of alliance is largely a political, not military, affair, once alliances are established, militaries play an important role in strengthening and maintaining them. Interoperability is considered a "cornerstone concept" of NATO and involves a variety of activities to align doctrine, procedures, and language between alliance members so that they can work effectively as a combined force.[23] Further, the acts of developing interoperability may strengthen the alliance through trust and relationship building.[24] As an illustrative example, consider the annual Garuda Shield exercise jointly led by the US and Indonesia and also involving other allied nations.[25] The exercise supports an alliance of nations that dispute Chinese claims on the South China Sea, affecting the prospect and outcome of a potentially globally catastrophic war between the US and China.

2.3 Side Effects of Violence

Military violence can also affect GCR via unintentional side effects. One example is the risk of pandemics. War has long been linked to the spread of disease. One of the key facilitators of the 1918 flu was World War I.[26] In 2020, the United Nations proposed a ceasefire in all conflict zones to reduce the spread of COVID-19.[27] The bleak conditions following a nuclear war may also accelerate the spread of infectious disease.[28]

Additionally, military conflict could affect efforts to mitigate other GCRs. Military campaigns, especially large-scale campaigns, can consume substantial portions of a country's resources and political attention. For example, Russia's invasion of Ukraine is currently causing the country acute financial difficulties due to economic sanctions and disinvestment in the civilian sector.[29] That can divert resources and attention away from other initiatives, including initiatives to reduce GCR. During

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[21] Keir A. Lieber and Daryl G. Press, "The New Era of Counterforce: Technological Change and the Future of Nuclear Deterrence," *International Security* 41, no. 4 (Spring 2017), 9–49, https://direct.mit.edu/isec/article/41/4/9/12158/The-New-Era-of-Counterforce-Technological-Change.

[22] Sulgiye Park, Allison Puccioni, and Francesca Verville, "Thermal Satellite Imagery for the Detection and Monitoring of Nuclear Weapons: Early Approaches for Automating Imagery Analysis," *HAI Seminar*, Stanford University (3 April 2024), https://hai.stanford.edu/events/thermal-satellite-imagery-detection-and-monitoring-nuclear-weapons-early-approaches.

[23] "Interoperability: A Cornerstone Concept of NATO," *NATO Allied Command Transformation* (28 May 2024), https://www.act.nato.int/article/interoperability-cornerstone-concept.

[24] Stephen J. Maranian, "NATO Interoperability: Sustaining Trust and Capacity within the Alliance," *NATO Defense College Research Papers* 115 (June 2015), https://www.files.ethz.ch/isn/192707/rp_115.pdf.

[25] Isaac Copeland, "Super Garuda Shield 2024: Uniting Forces at the Joint Operations Center," *USINDOPACOM* (6 September 2024), https://www.pacom.mil/Media/News/News-Article-View/Article/3898325/super-garuda-shield-2024-uniting-forces-at-the-joint-operations-center.

[26] Frederick Holmes, "The Influenza Pandemic and the War," *KU Medical Center,* https://www.kumc.edu/school-of-medicine/academics/departments/history-and-philosophy-of-medicine/archives/wwi/essays/medicine/influenza.html.

[27] António Guterres, "Now is the Time for a Collective New Push for Peace and Reconciliation," *United Nations* (23 March 2020), https://www.un.org/en/globalceasefire.

[28] Ira Helfand, "Nuclear Famine: Two billion people at risk," *International Physicians for the Prevention of Nuclear War,* http://www.ippnw.org/pdf/nuclear-famine-two-billion-at-risk-2013.pdf.

[29] Christina Harward, "Russia's Weakness Offers Leverage," *Institute for the Study of War* (19 February 2025), https://www.understandingwar.org/backgrounder/russias-weakness-offers-leverage.

the war, for example, Russia and Ukraine's climate emissions skyrocketed, while Russia also withdrew from various nuclear arms treaties, such as the Comprehensive Test Ban Treaty.[30] Another possibility is that, as militaries become increasingly dependent on space-based assets, combatants may target one another's space launch capabilities, thereby disrupting the capabilities needed to defend against near-Earth objects. For example, the November 2021 Double Asteroid Redirection Test was launched from Vandenberg Space Force base in California, which also provides command and control for space force operations, making it a desirable military target.[31]

Finally, environmental side effects are discussed in Section 4.1.

2.4 Violence to Reduce Risks

Finally, military acts of violence can, in some scenarios, reduce GCR. These scenarios generally involve another actor behaving in a way that could result in global catastrophe until or unless they are stopped by military force. While political command may make the primary decisions about whether and how to conduct these acts of violence, militaries lead the execution of the decisions and likewise play a central role in whether the acts succeed at preventing global catastrophe.

One set of scenarios involves militaries disrupting the development or deployment of dangerous weapons or other technology, for instance nuclear weapons, contagious biological weapons,[32] artificial intelligence,[33] or geoengineering.[34] Militaries can capture or kill key personnel, such as Israel's ongoing assassination of Iranian nuclear weapons scientists.[35] They can also attack industrial facilities, such as in the Israeli attacks on the Osirak reactor in Iraq in 1981 and the Al Kibar complex in Syria in 2007.[36] The US military develops plans, procedures, and capabilities to employ "tailored capabilities to neutralize or destroy weapons and agents; delivery systems; and materials, facilities, and processes, including the functional or structural defeat of hardened targets,"[37] with US Special Operations Command working with partner nations to prepare and exercise high-risk missions to impede or

[30] Andrew Osborn, "Putin Revokes Russian Ratification of Global Nuclear Test Ban Treaty," *Reuters* (2 November 2023), https://www.reuters.com/world/europe/putin-revokes-russias-ratification-nuclear-test-ban-treaty-2023-11-02; Nina Lakhani, "Russia's War with Ukraine Accelerating Global Climate Emergency, Report Shows," *The Guardian* (13 June 2024), https://www.theguardian.com/environment/article/2024/jun/13/russia-war-with-ukraine-accelerating-global-climate-emergency-report-shows.

[31] NASA Science Editorial Team, "DART Mission Launches!" *NASA* (24 November 2021), https://science.nasa.gov/blogs/dart/2021/11/24/nasas-dart-mission-launches; "Combined Space Operations Center / Space Delta 5," *U.S. Space Forces,* https://www.spaceforces-space.mil/Units/CSpOC-Combined-Space-Operations-Center.

[32] Jaime M. Yussif, Shayna Korol, and Angela Kane, "Guarding Against Catastrophic Biological Risks: Preventing State Biological Weapon Development and Use by Shaping Institutions," *Nuclear Threat Initiative* (10 December 2024), https://www.nti.org/analysis/articles/disincentivizing-bioweapons-theory-and-policy-approaches.

[33] Reinmar Nindler, "The United Nation's Capability to Manage Existential Risks with a Focus on Artificial Intelligence," *International Community Law Review* 21 (March 2019), 5–34, https://brill.com/view/journals/iclr/21/1/article-p5_3.xml.

[34] Florian Rabitz, "Going Rogue? Scenarios for Unilateral Geoengineering," *Futures* 84 (1 November 2016), 98–107, https://doi.org/10.1016/j.futures.2016.11.001; Andrew Lockley, Ishita Mundra, and Patrick Taylor Smith, "Legitimacy and Justifiability of Non-State Geoengineering," *Futures* 152 (1 September 2023), 103210, https://doi.org/10.1016/j.futures.2023.103210.

[35] William Tobey, "Overview: Nuclear Scientists as Assassination Targets," *Bulletin of the Atomic Scientists* (27 November 2020), https://thebulletin.org/premium/2020-11/overview-nuclear-scientists-as-assassination-targets.

[36] Or Rabinowitz and Giordana Pulcini, "The Israeli Raid Against the Iraqi Reactor – 40 Years Later: New Insights from the Archives," *Wilson Center* (3 June 2021), https://www.wilsoncenter.org/blog-post/israeli-raid-against-iraqi-reactor-40-years-later-new-insights-archives; Tom Bateman, "Israel Admits Striking Suspected Syrian Nuclear Reactor in 2007," *BBC* (21 March 2018), https://www.bbc.co.uk/news/world-middle-east-43481803.

[37] "Joint Publication 3-40: Joint Countering Weapons of Mass Destruction," *U.S. Joint Chiefs of Staff* (27 November 2019), available at https://irp.fas.org/doddir/dod/jp3_40.pdf.

prevent the development, acquisition, or use of weapons of mass destruction.[38] This program could be adapted for counter-GCR missions, even when the GCR cannot be classified as a weapon. Military use for sanctions enforcement to prevent another country from acquiring WMD could constitute a related, but more indirect, form of GCR risk reduction. A corollary of militaries acting to preemptively negate catastrophic risks is the potential role of the military in protecting risk mitigation efforts (such as a planetary defense mission to deflect a near-Earth object or NEO) from disruption by those who might seek to disrupt those efforts (who have elsewhere been referred to as "malicious spoilers"[39]).

Militaries could also play a key role in pushing back against totalitarian regimes to prevent them from acquiring more power and causing catastrophe.[40] Totalitarian regimes have caused some of the worst catastrophes in human history.[41] Future totalitarian regimes could be even worse, especially if they have access to dangerous military technology, and a stable global totalitarian regime has been argued to in itself constitute a GCR.[42] Military action to counter such regimes could reduce GCR, analogous to the actions of the Allies during World War II. However, militaries taking such action would need to ensure that the action itself would not cause global catastrophe.

3. Technology Research and Development

Militaries have significant and unique research and development capabilities due to their substantial resources and their broad interests in areas like biotechnology, quantum computing, artificial intelligence, encryption, and remote sensing. Militaries can pursue different technologies than the private sector due to their being both publicly funded (and therefore do not need to worry about profitability) and authorized to pursue national security. As a result, military research has led to globally impactful technologies like the global positioning system, the Internet, and duct tape.[43] Although these technologies are largely dual-use, it demonstrates the impact of military research and development. Military technology research and development relates to GCR in two ways: accidents and intentional misuse, and risk mitigation.

3.1 Accidents and Intentional Misuse

Given the powerful character of some military technology, a loss of control, whether accidental or intentional, could be catastrophic. For example, accidents in a bioweapon lab could result in pathogens escaping and initiating a pandemic. This risk is illustrated by the accidental release of *Bacillus anthracis* spores from a Soviet military research facility near Sverdlovsk in April 1979, which led to the deaths of at least 68 people from anthrax.[44] That was not the sort of contagious pathogen that could

[38] Brendan G. Melley, "The Role of Special Operations Forces in Countering Weapons of Mass Destruction," in *Strategic Latency Unleashed: The Role of Technology in a Revisionist Global Order and the Implications for Special Operations Forces,* edited by Zachary Davis, et al. (Lawrence Livermore National Laboratory, January 2021), https://cgsr.llnl.gov/sites/cgsr/files/2024-08/StratLatUnONLINE.pdf

[39] Zachary Kallenborn and Gary Ackerman, "Existential Terrorism: Can Terrorists Destroy Humanity?," *European Journal of Risk Regulation* 14, no. 4 (2023), 760-78.

[40] For totalitarianism as a GCR, see Bryan Caplan, "The Totalitarian Threat," in *Global Catastrophic Risks*, edited by Nick Bostrom and Milan M. Cirkovic (Oxford University Press, 2008), https://doi.org/10.1093/oso/9780198570509.003.0029.

[41] Ibid.

[42] Ibid.

[43] "Military Inventions that we Use Everyday," *NATO*, accessed via https://web.archive.org/web/20250819020013/https://www.nato.int/cps/fr/natohq/declassified_215371.htm?msg_pos=1.

cause a pandemic, but it nonetheless indicates the potential for a catastrophic military bioweapons accident.

Intentional misuse could be by a military insider or an external actor. While there have been no known thefts of intact nuclear weapons, there have been several plots to steal them,[45] as well as multiple cases of fissile material being stolen or trafficked.[46] In addition to weapons themselves, other potentially dangerous technology could fall out of military control. In 2016, multiple advanced hacking tools, allegedly sourced from the US National Security Agency, were leaked by a group calling itself the Shadow Brokers.[47] Although hacking tools will in most cases not on their own constitute a global catastrophe, a future advanced military artificial intelligence system escaping into the wild could markedly increase GCR.

3.2 Risk Mitigation

Military technologies could also directly help prevent catastrophe. For example, militaries engage in defensive biological research for the purposes of preventing or treating against enemy bioweapons, which can also help protect against natural pandemics.[48] Another example is the potential use of nuclear weapons for planetary defense missions against an approaching NEO, discussed in greater depth in section 5.2: Planetary Defense.

Militaries can also contribute towards mitigating technological GCRs through forecasting and assessing risk. In recent years, militaries have applied their longstanding capabilities in wargaming and red teaming to technological risks. For example, the US Department of Defense has conducted and encouraged red teaming to evaluate risks emerging from artificial intelligence.[49] Such assessments help to identify and characterize the impacts of emerging technologies which could boost or hamper military effectiveness, but at the same time can raise more general awareness of emerging risks and risk mitigation opportunities that could be used to prevent global catastrophe.

Military computational modeling capabilities are another factor. Militaries have long sunk significant resources into modeling and simulation capabilities, for example by investing in ever larger

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[44] Matthew Meselson et al., "The Sverdlovsk Anthrax Outbreak of 1979," *Science* 266, no. 5188 (18 November 1994), 1202–08, https://doi:10.1126/science.7973702.

[45] Gary Ackerman, Charles Blair, and Maranda Sorrells, "Radiological and Nuclear Non-State Adversaries Database (RANNSAD)," *Harvard Dataverse V1* (2011), https://doi.org/10.7910/DVN/SCGOJE.

[46] The IAEA reports at least 160 incidents of malicious use or trafficking of nuclear materials between 1993 and 2023; see "IAEA Incident and Trafficking Database: Factsheet 2024," *IAEA* (2024), https://www.iaea.org/sites/default/files/24/05/itdb_factsheet_2024.pdf. A startling case was even reported as recently as February 2024; see "Justice Department Announces Nuclear Materials Trafficking Charges Against Japanese Yakuza Leader," *U.S. Department of Justice Office of Public Affairs Press Release Number 24-199* (21 February 2024), https://www.justice.gov/opa/pr/justice-department-announces-nuclear-materials-trafficking-charges-against-japanese-yakuza.

[47] BBC News, "'NSA Malware' Released by Shadow Brokers Hacker Group," *BBC News* (10 April 2017), https://www.bbc.co.uk/news/technology-39553241.

[48] J. M. Gambel and R. G. Hibbs, "U.S. Military Overseas Medical Research Laboratories," *Military Medicine* 161, no. 11 (November 1996), 638–45.

[49] George I. Seffers, "Army Cyber Researchers Develop AI Red Teaming Capabilities," *AFCEA International* (1 August 2024), https://www.afcea.org/signal-media/cyber-edge/army-cyber-researchers-develop-ai-red-teaming-capabilities; Defense Innovation Board, "Defense Innovation Board's AI Principles Project," *U.S. Department of Defense*, accessed via https://web.archive.org/web/20260107013131/https://innovation.defense.gov/ai;

supercomputers.[50] One application of this is simulating nuclear weapons detonations.[51] Military supercomputers could also be used to mitigate certain GCRs like biothreats,[52] and potentially even climate change through better modeling of impacts and the effects of mitigation measures.[53]

4. Environmental Impact

As large organizations with numerous personnel, vehicles, and facilities, militaries can significantly affect the environment. Militaries also possess unique capabilities that can affect the environment in both positive and negative ways.

4.1 Environmental Footprint

The military and defense industry's impact on the environment is sizable. This includes greenhouse gas emissions (e.g., from land, air, and sea vehicles) and the impacts of weapons use. The Conflict and Environment Observatory notes that in 2021 the number of military aircraft worldwide (53,563 aircraft) was over double the number of civilian aircraft (23,715).[54] The Observatory further notes that "Overall, aviation represents around 3.5% of climate warming, and the role of military aviation is currently estimated at between 8% to 15% of this total."[55] Militaries have significant motivation to pursue more sustainable fuels. In addition to environmental concerns, there is also an important operational component. If wartime hostilities affect the supply chain and fuel runs out (or becomes far less available), then it becomes difficult to sustain a sufficient fighting force. The U.S. Navy has long used nuclear-powered vessels, and it is also pursuing biofuels and hybrid energy approaches.[56]

Militaries have increasingly recognized the national security impacts of climate change and sought to understand and combat them. In 2022, NATO released its "Climate Change and Security Impact Assessment" stating, "climate change is the overarching challenge of our time," and "that NATO

[50] Aleah M. Castrejon, "AFRL's newest supercomputer 'Raider' promises to compute years' worth of data in days, saving time, money," *Air Force Research Laboratory* (11 September 2023), https://www.afrl.af.mil/News/Article-Display/Article/3521947/afrls-newest-supercomputer-raider-promises-to-compute-years-worth-of-data-in-da; Brandi Vincent, "Navy's New $25M Supercomputer Equipped with Cutting Edge AI and Machine Learning 'Accelerators'," *DefenseScoop* (23 August 2023), https://defensescoop.com/2023/08/23/navys-new-25m-supercomputer-equipped-with-cutting-edge-ai-and-machine-learning-accelerators; David McNally, "Supercomputers Save Lives, Money for Army," *U.S. Army* (26 May 2017), https://www.army.mil/article/188404/supercomputers_save_lives_money_for_army.

[51] Timothy Prickett Morgan, "Nuclear Weapons Drove Supercomputing, And May Now Drive It Into The Clouds," *The Next Platform* (19 April 2023), https://www.nextplatform.com/2023/04/19/nuclear-weapons-drove-supercomputing-and-may-now-drive-it-into-the-clouds.

[52] "DOD Introduces New Supercomputer Focused on Biodefense Capabilities," *U.S. Department of Defense (*15 August 2024), https://www.defense.gov/News/Releases/Release/Article/3875539/dod-introduces-new-supercomputer-focused-on-biodefense-capabilities.

[53] Neal Singer, "Cloud-Resolving Climate Model Meets World's Fastest Supercomputer," *Sandia National Laboratories* (6 April 2023), https://www.sandia.gov/labnews/2023/04/06/cloud-resolving-climate-model-meets-worlds-fastest-supercomputer.

[54] Linsey Cottrell and Eoghan Darbyshire, "The Military's Contribution to Climate Change," *Conflict and Environment Observatory* (16 June 2021), https://ceobs.org/the-militarys-contribution-to-climate-change.

[55] Ibid.

[56] "Great Green Fleet," *AllHands,* https://allhands.navy.mil/Features/GGF; H. Scott Coombe, "Code 33 Power and Energy Focus Area," *Office of Naval Research*, https://www.onr.navy.mil/organization/departments/code-33/power-and-energy-focus-area.

should aim to become the leading international organization when it comes to understanding and adapting to the impact of climate change."[57] NATO then announced the "Allies' decision to reduce gas emissions by at least 45% by 2030, down to net zero by 2050."[58] NATO produced subsequent reports in 2023 and 2024, and while these do not appear to offer an assessment of progress towards these goals, they do continue to highlight the urgency of climate change impacts and increasing security and force sustainability issues.[59]

4.2 Environmental Monitoring

Militaries often have the resources to closely monitor environmental conditions and thus can provide warning of potentially problematic changes. For example, the US military has been contributing to Space-Based Environmental Monitoring for five decades.[60] Per the US National Oceanic and Atmospheric Administration: "[Defense meteorological satellites] provide the military with important environmental information used in planning and conducting military operations worldwide and important weather data used to increase the timeliness and accuracy of weather forecasts around the globe."[61] The program had classified origins starting in 1962, and was declassified in 1972.[62] Although the meteorological program has been criticized for its aging satellite constellation, and having only two satellites remaining, the Space Force has plans to supplement this constellation with its new "Weather System Follow-on Microwave" satellites.[63] The first of these was launched April 11, 2024.[64]

4.3 Geoengineering

Geoengineering refers to the intentional manipulation of the global environment, especially to counteract the effects of climate change. One common approach is stratospheric geoengineering, in which particles are put into the stratosphere to reflect incoming sunlight, thereby reducing temperatures at the surface. However, stratospheric geoengineering can fail, causing a catastrophe worse than regular

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[57] "Climate Change & Security Impact Assessment," *NATO* (2022), accessed via https://web.archive.org/web/20250812053324/https://www.nato.int/nato_static_fl2014/assets/pdf/2022/6/pdf/280622-climate-impact-assessment.pdf.

[58] "NATO releases its Climate Change and Security Impact Assessment," *NATO* (28 June 2022), https://www.nato.int/en/news-and-events/articles/news/2022/06/28/nato-releases-its-climate-change-and-security-impact-assessment.

[59] "The Secretary General's Report: NATO Climate Change and Security Assessment, Second Edition, 2023," *NATO* (2023), https://www.nato.int/content/dam/nato/legacy-wcm/media_pdf/2023/7/pdf/230711-climate-security-impact.pdf; "The Secretary General's Report: NATO Climate Change and Security Assessment, Third Edition, 2024," *NATO* (2024), https://www.nato.int/content/dam/nato/legacy-wcm/media_pdf/2024/7/pdf/240709-Climate-Security-Impact.pdf.

[60] "Defense Meteorological Satellite Program," *U.S. Space Force* (October 2020), https://www.spaceforce.mil/About-Us/Fact-Sheets/Article/2197779/defense-meteorological-satellite-program.

[61] Ibid.

[62] Ibid.

[63] Sandra Erwin, "As Military Weather Satellites near End of Life, DoD Turns to Partners for Data," *SpaceNews* (21 November 2023), http://spacenews.com/as-military-weather-satellites-near-end-of-life-dod-turns-to-partners-for-data; Allison Barto, "Weather System Follow-on-Microwave," *BAE Systems*, https://www.baesystems.com/en-us/product/wsf-m.

[64] Media Relations Division, "Space Systems Command successfully launches next generation WSF-M weather satellite on SpaceX Falcon 9 rocket from California," *U.S. Space Systems Command* (11 April 2024), https://www.ssc.spaceforce.mil/Portals/3/Documents/PRESS%20RELEASES/Space%20Systems%20Command%20successfully%20launches%20next%20generation%20WSF-M%20weather%20satellite%20on%20SpaceX%20Falcon%209%20rocket%20from%20California.pdf.

climate change.[65] Given the risks, international consensus may remain elusive, but stratospheric geoengineering could be executed unilaterally by states or even private actors.[66] Consequently, the US military has sought to assess the risks of rogue geoengineering, and could contribute to monitoring, attribution, and protective actions.[67] If international efforts manifest in new international norms and treaties concerning geoengineering, militaries may be called upon to support the enforcement of those regulations. Conversely, states particularly threatened by climate change may perceive geoengineering as being in the interests of their national survival, utilizing their military and national security apparatus to undertake geoengineering and shield their activities from international scrutiny.

5. Outer Space

Militaries have long been critical to the development of state space capabilities. The US Department of Defense was a major contributor to the early Space Race. The US Army's first edge-of-space and space rockets in the 1940s, the Navy's Viking rockets and Army's Mercury rockets in the 1950s, and the Air Force's contribution to solid propulsion, booster systems, and other manned space mission system research in the 1950s and 1960s are all among the substantial contributions of the US military services that ultimately enabled the Apollo missions to the lunar surface.[68] In outer space, militaries can affect GCR along three dimensions: militarization, planetary defense, and extraterrestrial life.

5.1 Militarization of Outer Space

Space is "the ultimate high ground," providing strategic opportunities to observe adversary forces.[69] Military satellites collect critical intelligence on adversary forces (e.g., indications and warning of ballistic missile launches), troop movements, capability development, and more. For decades, space-based early warning radar systems have acted as a key part of nuclear deterrence in the US, adversary, and partner nations.[70] The US Space Force is currently in the process of upgrading these systems.[71]

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[65] Seth D. Baum, Timothy M. Maher, and Jacob Haqq-Misra, "Double Catastrophe: Intermittent Stratospheric Geoengineering Induced by Societal Collapse," *Environment Systems and Decisions* 33, no. 1 (2013), 168–80, https://doi.org/10.1007/s10669-012-9429-y; Aaron Tang and Luke Kemp, "A Fate Worse Than Warming? Stratospheric Aerosol Injection and Global Catastrophic Risk," *Frontiers in Climate* 3 (November 2021), 720312, https://doi.org/10.3389/fclim.2021.720312.

[66] David G. Victor, "On the Regulation of Geoengineering," *Oxford Review of Economic Policy* 24, no. 2 (2008), 322–36, https://doi.org/10.1093/oxrep/grn018; Florian Rabitz, "Going Rogue? Scenarios for Unilateral Geoengineering," *Futures* 84 (November 2016), 98–107, https://doi.org/10.1016/j.futures.2016.11.001.

[67] "America's Defence Department Is Looking for Rogue Geoengineers," *The Economist* (2 November 2022), https://www.economist.com/science-and-technology/2022/11/02/americas-defence-department-is-looking-for-rogue-geoengineers.

[68] David Vergun, "DOD Played Significant Role in Lead-up to Apollo 11 Moon Mission," *U.S. Department of Defense* (15 July 2019), https://www.defense.gov/News/Feature-Stories/story/Article/1901239/dod-played-significant-role-in-lead-up-to-apollo-11-moon-mission.

[69] Benjamin S. Lambeth, *Mastering the Ultimate High Ground: Next Steps in the Military Uses of Space* (RAND Corporation, 2003), https://www.rand.org/pubs/monograph_reports/MR1649.html; A. J. Bosker, "Space is Ultimate High Ground," *U.S. Air Force Print News* (27 May 2003), https://www.af.mil/News/Article-Display/Article/139149/space-is-ultimate-high-ground.

[70] Peter L. Hays and James J. Wirtz, "Enabling National Security through Space: Intelligence and Communications," in *The Oxford Handbook of Space Security, Oxford Handbooks*, edited by Saadia M. Pekkanen and P.J. Blount (Oxford University Press, 2024), https://doi.org/10.1093/oxfordhb/9780197582671.013.39.

[71] "Upgraded Early Warning Radars," *U.S. Space Force* (October 2020), https://www.spaceforce.mil/About-Us/Fact-

Satellites can also provide important insights into trends and the emergence of global catastrophes, such as the potential outbreak of global war or the production or use of nuclear and biological weapons, or the production of new AI-related data centers. Space can also serve as a platform for nuclear-armed ballistic missiles and the means to destroy adversary space-based assets.

Militarization of outer space could interfere with the global cooperative benefits of outer space collaboration, thereby increasing conflict-related GCR. Outer space is often seen as a setting for international unity and harmony, such as in cooperation on the International Space Station or the famous Pale Blue Dot photograph that evokes a common humanity. This can in turn enhance international cooperation, including on GCR. International initiatives such as the Outer Space Treaty establish principles to reduce the militarization of outer space and enhance international cooperation.[72] For the most part, states have observed these principles. A possible exception is China's 2007 anti-satellite missile test.[73] The test sparked considerable international blowback, indicating the international community's commitment to a non-militarized outer space.[74]

5.2 Planetary Defense

Militaries can contribute to planetary defense from NEOs, including in support roles for civilian space agencies. In the US, the Air Force played this role until it was transitioned in 2019 to the new Space Force.[75] The Space Force's Space Surveillance Telescope and broader space domain awareness capabilities provides crucial support to NEO detection and characterization.[76] Using military assets for NEO surveillance can have some drawbacks, such as difficulties in militaries sharing information with civilian agencies.[77] Nonetheless, militaries can and do make important contributions to NEO surveillance.

Sheets/Fact-Sheet-Display/Article/2197738/upgraded-early-warning-radars.

[72] U.N. General Assembly, "Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space," *United Nations Office for Outer Space Affairs (*13 December 1963), https://www.unoosa.org/oosa/en/ourwork/spacelaw/principles/legal-principles.html; U.N. General Assembly, "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies," *United Nations Office for Outer Space Affairs,* https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html.

[73] Brendan Nicholson and Foreign Affairs Correspondent, "World Fury at Satellite Destruction," *The Age* (20 January 2007), https://www.theage.com.au/national/world-fury-at-satellite-destruction-20070120-ge416d.html; Hui Zhang, "Action/Reaction: U.S. Space Weaponization and China," *Arms Control Association* (December 2005), https://www.armscontrol.org/act/2005-12/features/actionreaction-us-space-weaponization-and-china.

[74] Victoria Samson. "Chinese Direct Ascent Anti-Satellite Testing Fact Sheet," *Secure World Foundation* (12 June 2026), https://www.swfound.org/publications-and-reports/chinese-direct-ascent-anti-satellite-testing-fact-sheet.

[75] Interagency Working Group for Detecting and Mitigating the Impact of Earth-bound Near-Earth Objects, "National Near-Earth Object Preparedness Strategy and Action Plan," *National Science and Technology Council* (2018 June), https://www.nasa.gov/wp-content/uploads/2022/03/ostp-neo-strategy-action-plan-jun18.pdf; Planetary Defense Interagency Working Group, "National Preparedness Strategy & Action Plan for Near-Earth Object Hazards and Planetary Defense," *National Science and Technology Council* (April 2023), https://assets.science.nasa.gov/content/dam/science/psd/planetary-science-division/2025/2023-NSTC-National-Preparedness-Strategy-and-Action-Plan-for-Near-Earth-Object-Hazards-and-Planetary-Defense.pdf.

[76] "Memorandum of Understanding Between the National Aeronautics and Space Administration and The United States Space Force," *National Aeronautics and Space Administration and U.S. Space Force,* September 2020, https://www.nasa.gov/wp-content/uploads/2015/01/nasa_ussf_mou_21_sep_20.pdf.

[77] "Planetary Defense Interagency Tabletop Exercise 5: After-Action Report," *NASA Planetary Defense Coordination Office PD TTX5* (2–3 April 2024), https://cneos.jpl.nasa.gov/pd/cs/ttx24/TTX5_AAR.pdf.

Militaries can also contribute to NEO deflection in the event that an Earth-bound NEO is detected. Militaries can play a role in missions involving any deflection technique, but their role is especially important when deflection uses nuclear explosives. Planetary defense research finds that nuclear explosives may be the most effective option, especially for the largest NEOs, which also pose the highest catastrophic risks.[78] Military expertise is needed to build, maintain, and deploy a nuclear explosive. This can reduce the GCR from NEOs, though it can also increase nuclear war risk, such as by weakening the taboo against nuclear weapons use.[79]

5.3 Extraterrestrial Life

While extraterrestrial life (sentient or otherwise) has not yet been discovered, the possibility remains. The SETI Institute estimates as many as 300 million planets in the Milky Way galaxy alone could potentially support life.[80] The discovery of extraterrestrial life, and especially extraterrestrial intelligence, could pose GCRs. Even just the knowledge of the existence of an intelligent, extraterrestrial species could generate significant geopolitical instability. An advanced extraterrestrial species could provide insights of large significant scientific, economic, and military value, and so states may compete and even go to war over the right to communicate with the extraterrestrial intelligence.

In an extraterrestrial contact scenario, militaries would likely play important roles in managing interstate competition, assessing threats posed by the extraterrestrials, and, if need be, defending against those threats. Military intelligence would likely seek to assess extraterrestrial military capabilities and assets, as well as identify various planning scenarios and how they interact with existing geopolitical dynamics. Assessing the intentions and goals of other militaries and states is a core military intelligence function. However, assessing whether an extraterrestrial species is, for example, cooperative or conflictual, is made difficult by the profound differences that may exist between humans and the extraterrestrials. Nonetheless, at the extreme end, hostile extraterrestrial life could pose a GCR.[81]

6. Catastrophe Management

How catastrophes are managed affects the severity of their consequences. For global catastrophes, management includes efforts to prevent civilization from collapsing, support survivors, and facilitate the long-term recovery of civilization.[82] Many militaries have extensive expertise and capabilities in catastrophe management because war itself involves catastrophic conditions and because militaries are often tasked with responding to other catastrophes in humanitarian missions, such as natural disaster

[78] National Research Council, *Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies*, (The National Academies Press, 2010).
[79] Seth D. Baum, "Risk-Risk Tradeoff Analysis of Nuclear Explosives for Asteroid Deflection," *Risk Analysis* 39, no. 11 (2019), 2427–42, https://doi.org/10.1111/risa.13339.
[80] SETI Institute, "How Many Habitable Planets are Out There?," *SETI Institute* (29 October 2020), https://www.seti.org/press-release/how-many-habitable-planets-are-out-there.
[81] Seth D. Baum, Jacob D. Haqq-Misra, and Shawn D. Domagal-Goldman, "Would Contact with Extraterrestrials Benefit or Harm Humanity? A Scenario Analysis," *Acta Astronautica* 68, no. 11-12 (June-July 2011), 2114-2129, https://doi.org/10.1016/j.actaastro.2010.10.012.
[82] Seth D. Baum, "Resilience to Global Catastrophe," in *IRGC Resource Guide on Resilience (Vol. 2): Domains of Resilience for Complex Interconnected Systems*, edited by Benjamin D. Trump, Marie-Valentine Florin, and Igor Linkov, (EPFL International Risk Governance Center, 2018), https://irgc.epfl.ch/risk-governance/projects-resilience; Baum, et al., "Long-Term Trajectories of Human Civilization" (note 7).

response. This can be applied to managing global catastrophes[83] The military's role in global catastrophe management has four dimensions: resilience to catastrophes, catastrophe survival, resource stockpiles, and response and recovery.

6.1 Resilience to Catastrophes

Militaries bolster resilience by protecting infrastructure against catastrophes. For example, the US military is tasked with monitoring for electromagnetic pulses;[84] military standards such as the US MIL-STD-188-125-1 and -2 require critical systems to be hardened against electromagnetic pulses.[85] Electromagnetic pulses can cause catastrophic failures of electrical systems.

GCR can also be exacerbated by tightly interconnected global systems, such as global supply chains. In these systems, shocks in one location propagate around the world, compounding the severity.[86] Shocks can also propagate across sectors; for example, during the COVID-19 pandemic, changes in demand caused supply disruptions that cascaded across different industries.[87] GCR can be reduced by increasing resilience to such shocks. Militaries play an important role in safeguarding global economic stability and securing vital supply chains. Militaries protect critical maritime chokepoints to ensure the continuity of global shipping routes.[88] Although still limited, militaries also increasingly support the cybersecurity of critical infrastructure. For example, NATO's Integrated Cyber Defence Center, the U.S. Joint Cyber Defense Collaborative, and the UK's National Cyber Security Centre increasingly combine military, intelligence, civilian cybersecurity organizations, and critical infrastructure owners and operators into a common organizational construct.[89] To the extent that militaries' resilience initiatives also address the types of shocks that could result in global catastrophe, that is an important contribution to reducing GCR.

6.2 Catastrophe Survival

In many catastrophe scenarios, a critical challenge is basic survival during the catastrophe event and in its immediate aftermath. Militaries have deep experience with this, especially those that have made plans for nuclear war. As early as 1937, the British Army began building an alternative command center for the British military and civilian leadership at PADDOCK in Dollis Hill.[90] The center was

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[83] Department of Homeland Security, "Electromagnetic Pulse Shielding Mitigations: Best Practices for Protection of Mission Critical Equipment," *Department of Homeland Security,* August 2022, https://www.dhs.gov/sites/default/files/2022-09/22_0902_st_emp_mitigation_best_practices.pdf.

[84] Executive Office of the President, "Executive Order 13865: Coordinating National Resilience to Electromagnetic Pulses," *U.S. Federal Register* (26 March 2019), https://www.federalregister.gov/documents/2019/03/29/2019-06325/coordinating-national-resilience-to-electromagnetic-pulses.

[85] Department of Homeland Security 2022 (note 83).

[86] M. A. Centeno, Nag, M., Patterson, T. S., Shaver, A., and Windawi, A. J., "The Emergence of Global Systemic Risk," *Annual Review of Sociology* 41 (2015), 65-85, https://doi.org/10.1146/annurev-soc-073014-112317.

[87] Javid Moosavi, Amir M. Fathollahi-Fard, and Maxim A. Dulebenets, "Supply Chain Disruption during the COVID-19 Pandemic: Recognizing Potential Disruption Management Strategies," *International Journal of Disaster Risk Reduction* 75 (1 June 2022), 102983, https://doi.org/10.1016/j.ijdrr.2022.102983.

[88] Jonathan Masters, "Sea Power: The U.S. Navy and Foreign Policy," *Council on Foreign Relations* (12 June 2024), https://www.cfr.org/backgrounder/sea-power-us-navy-and-foreign-policy.

[89] Andrea Rigoni, "Reinventing Cyber Defence: Why We Need a New Doctrine to Defend Our Nations," *RUSI* (23 May 2025), https://www.rusi.org/explore-our-research/publications/commentary/reinventing-cyber-defence-why-we-need-new-doctrine-defend-our-nations.

intended to ensure the British government survived major bombing raids.[91] During the Cold War, Soviet Civil Defense forces invested heavily in constructing bomb shelters against nuclear attacks.[92]

Shelters like these may also provide protection against a variety of catastrophe scenarios, serving as refuges to ensure at least some people survive.[93] For example, during the 1963 Northeastern power blackouts, the US used the Mount Weather Emergency Operations Center to maintain government operations.[94] Mount Weather has on-site power, sewage systems, and drinking water, which is applicable to any catastrophe where critical national infrastructure is compromised.[95] Militaries could develop similar facilities to ensure survival across a range of global catastrophe scenarios.

6.3 Resource Stockpiles

Survivors of a global catastrophe may face acute shortages of basic resources due to the collapse of supply chains and other effects of the catastrophe. In these conditions, resource stockpiles can be of great value. Militaries can be of considerable help with this. Militaries are responsible for building and maintaining stockpiles of supplies needed for extended conflict.[96] This includes military vehicles and ammunition as well as fuel, food, medical supplies, and other basic goods.[97] These stockpiles could support both military and civilian populations following a global catastrophe.

6.4 Response and Recovery

Finally, in the aftermath of global catastrophe, response efforts are needed to recover whatever portions of civilization have been destroyed. Militaries can play important roles in this. Militaries tend to excel at logistics – moving large volumes of people, heavy equipment, and supplies from one point to another across land and, for naval powers, across sea. That is a valuable capability for response efforts. For example, after the 2004 Indian ocean earthquake and tsunami, the Indian military rapidly deployed ships, aircraft and helicopters across five simultaneous rescue missions.[98] Militaries can also provide a

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[90] Steve Fox, "Where Did the Government Go," *Subterranea Britannica*, https://www.subbrit.org.uk/features/where-did-the-government-go.

[91] Ibid.

[92] Edward Geist, "Was There a Real 'Mineshaft Gap'?: Bomb Shelters in the USSR, 1945–1962," *Journal of Cold War Studies* 14, no. 2 (2012), 3–28, https://doi.org/10.1162/JCWS_a_00219; C.I.A. Office of Research and Reports, "Civil Defense in the USSR and the European Satellites," *U.S. Central Intelligence Agency* (18 June 1954), https://www.cia.gov/readingroom/docs/DOC_0000496419.pdf.

[93] Seth D. Baum, David C. Denkenberger, and Jacob Haqq-Misra. "Isolated Refuges for Surviving Global Catastrophes," *Futures* 72 (September 2015), 45-56: https://doi.org/10.1016/j.futures.2015.03.009.

[94] "Mount Weather / High Point Special Facility (SF) / Western Virginia Office of Controlled Conflict Operations - United States Nuclear Forces," *Federation of Atomic Scientists*, https://nuke.fas.org/guide/usa/c3i/mt_weather.htm.

[95] Ibid.

[96] Other government divisions may also manage stockpiles. For example, the US Department of Health and Human Services manages the Strategic National Stockpile of medical supplies and the Department of Energy manages the Strategic Petroleum Stockpile. See Anshu Siripurapu and Noah Berman, "The State of U.S. Strategic Stockpiles," *Council on Foreign Relations* (2 March 2023), https://www.cfr.org/backgrounder/state-us-strategic-stockpiles.

[97] Cameron M. Keys, "Defense Primer: Department of Defense Pre-Positioned Materiel," *Congressional Research Service* (12 December 2024), https://www.congress.gov/crs-product/IF11699. Daniel Manlolov and Nikolay Kamarashev, "State Reserve and Wartime Stocks of the Republic of Bulgaria – Essence and Cost," *International Conference Knowledge-Based Organization* 24, no. 1 (June 2018), 137–41, https://doi.org/10.1515/kbo-2018-0020.

[98] "Government of India Expresses Solidarity with the Government and the People of Indonesia on the Solemn Occasion of Indian Ocean Tsunami Disaster Commemoration," *Embassy of India, Jakarta* (24 December 2014), https://www.mea.gov.in/Portal/CountryNews/3398_Press_Release_-

variety of portable capacities, such as medicine, logistics, and communications; these can augment civilian teams, which are likely to be overwhelmed by the catastrophe.[99] In global catastrophe scenarios, military capabilities may be significantly reduced; dedicated planning and preparedness initiatives could improve post-catastrophe performance and improve prospects for the rebuilding of civilization.

7. Overarching Trends

The survey presented above can be used to assess overarching trends in the role of militaries in GCR. We make our assessment using the GCR themes of Sections 2-6 and the following scheme for classifying the military's role in GCR:

- **Direct risk driver**: Militaries are responsible for directly causing a global catastrophe, such as by producing and using biological weapons.
- **Indirect risk driver**: Militaries are responsible for supporting other actors in the manifestation of a global catastrophe, such as by providing general support for advances in artificial intelligence.
- **Direct risk mitigator**: Militaries are responsible for directly preventing or mitigating a global catastrophe, such as militaries fighting against rogue actors producing biological weapons.
- **Indirect risk mitigator**: Militaries are responsible for supporting other actors in the prevention or mitigation of a global catastrophe, such as by contributing to a general sense of order and structure to ensure society's stability during and after catastrophe events.

We assess militaries as having low, medium, or high impact across each GCR theme and role. A high impact implies that militaries are critical actors in the risk scenarios, whereas a low impact means they have at most a limited role; a medium impact is somewhere in between. Table 1 presents our assessment. It shows the subjective assessment of the authors; other analysts may reach different conclusions in some cases, but we believe the general trends presented in Table 1 are consistent with the evidence about militaries and GCR. The assessment shows significant variation across different dimensions, whereby the military is quite critical as both risk driver and mitigator to GCR issues related to acts of violence, while playing a minimal—though still important—role in environmental issues. In the Outer Space dimension, the military likely plays a net positive role for GCR reduction, while the military likely plays a net negative role when it comes to Technology Research and Development, though still plays an important role in mitigating some scenarios.

_Government_of_India_expresses_solidarity_with_the_Government_and_the_people_of_Indonesia_on_the_solemn_occasion_of_Indian_Ocean_Tsunami_Disaster_commemoration.pdf.

[99] "2015 to 2020 Government Policy: Military Aid to the Civil Authorities for Activities in the UK," *U.K. Ministry of Defense* (4 August 2016), https://www.gov.uk/government/publications/2015-to-2020-government-policy-military-aid-to-the-civil-authorities-for-activities-in-the-uk/2015-to-2020-government-policy-military-aid-to-the-civil-authorities-for-activities-in-the-uk; Kristy N. Kamarck, Hannah D. Dennis, and Nicholas M. Munves, "Defense Primer: Defense Support of Civil Authorities," *Congressional Research Service* (9 April 2025), https://crsreports.congress.gov/product/pdf/IF/IF11324.

	Direct Risk Driver	Indirect Risk Driver	Direct Risk Mitigator	Indirect Risk Mitigator
Acts of Violence	High	High	High	High
Technology Research and Development	High	Medium	Medium	Low
Environmental Impact	Medium	Low	Low	Low
Outer Space	Low	Low	Medium	High
Catastrophe Management	Low	Low	Medium	Medium

Table 1. Overarching trends in the role of militaries in GCR.

8. Conclusion

This paper presents a scoping review of the ways in which militaries affect GCR. Although militaries may be seen as increasing GCR, especially in scenarios involving nuclear and biological weapons, the paper shows that their overall role in GCR is more nuanced and complex. Sometimes militaries may play a crucial role in mitigating a risk scenario, while acting as an indirect or subtle risk driver in others. Militaries support diplomatic, economic, political, and social systems in protecting and preserving the broader international system, which in itself enables a variety of global cooperation—including potentially working to mitigate GCRs.

The survey presented in this paper is quite broad and inevitably lacks depth in many facets of the roles of militaries in GCR. We intend it not as the final word on the topic, but instead as an initial overview and potentially also as a launchpad for a more detailed characterization of specific aspects of the relationship between militaries and GCR. Future research could expand this paper's assessment. For example, studies could explore the likely impact of military decisions and actions in specific risk scenarios, using literature reviews and expert surveys to more precisely capture the ways in which militaries affect the scenario's risk. Many of the scenarios involving hostile action, such as nuclear war and bioweapons, represent well-studied existing sub-fields in international security, so researchers could use a GCR lens to focus on the role of militaries in those scenarios. Research could also focus on gaps and opportunities: what roles might militaries and defense institutions play that they are not already? Similar approaches could also be applied to other policy organizations or areas, such as the role of intelligence agencies in driving or mitigating GCR.[100]

The importance of militaries to many GCR issues means they also should be brought into larger academic and policy discussions about GCR. Input from military officials and military-oriented policy researchers and thinkers are especially critical for areas of GCR that overlap significantly with areas of

[100] Rumtin Sepasspour, "Existential Espionage: How Intelligence Gathering can Protect Humanity," *Bulletin of the Atomic Scientists* (21 April 2023), https://thebulletin.org/2023/04/existential-espionage-how-intelligence-gathering-can-protect-humanity/#post-heading.

long-standing defense interest, such as weapons of mass destruction, counterterrorism, cyber warfare, and insider threats. Conversely, defense officials should more consciously and deliberately incorporate GCR into larger defense planning and long-term foresight activities. For example, ministries of defense, in collaboration with internal affairs and intelligence communities, might establish regular, comprehensive assessments of the likelihood of various global catastrophe scenarios and their countries' vulnerability to them. They might also integrate GCR-related issues into other relevant policy areas, such as intelligence sharing around potential global catastrophic terrorist threats.[101] In addition, analytical groups could be developed and maintained to better analyze and explore specific aspects of global catastrophe scenarios. Because a global catastrophe would necessarily affect numerous states, global militaries should also identify and develop venues and facilitating policies and regulations for mutual aid.

Ultimately, militaries are one of many players in the GCR space, but they are often critical ones with unique relationships to several types of potential global catastrophe. Work on GCR reduction should make a point of taking militaries into account and, where opportunities exist, engaging with militaries to reduce GCR.

[101] Kallenborn and Ackerman 2023 (note 39).

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