



Scenario-Based Simulations for Climate Security: Enhancing Rapid Response to Converging Crises

Ryan Atkinson

Carleton University, Ottawa, Canada, <https://carleton.ca/>

Abstract: Climate security challenges require coordinated, rapid responses across civilian and military sectors to enhance readiness and foster resilience. A scenario-based analysis of dual-use technologies supports strengthened civil-military collaboration to address simultaneous climate security crises. Real-world events are drawn upon to create a scenario that illustrates the concept of converging crises, which are cross-domain, dual-use, and co-occurring incidents that challenge traditional rapid response frameworks. AI-powered tools and uncrewed systems may help organizations make better decisions by coordinating and learning through case study-based training on contingency crises, such as those involving wildfires and the Arctic. Scenario-based planning helps identify problems with governance and coordination in simulated environments, thereby supporting readiness to build critical climate security scenarios and rapid response measures.

Keywords: dual-use technology, climate security, artificial intelligence, uncrewed aerial systems, UAS, scenario-based analysis, wildfire management, arctic monitoring, civil-military interoperability.

Introduction: Climate Security Crises and Dual-Use Technology

An increasingly complex threat landscape demands adaptation to climate security challenges. Scenario-based analysis provides customized training to address interdisciplinary security threats across multiple domains, involving dual-use technologies with both civilian and military applications. This study focuses specifically on the challenge of responding rapidly to climate-related security threats that occur concurrently and involve dual-use technologies, necessitating an examination of civil-military collaboration for rapid response.

In recent years, unprecedented climate-related defence and security incidents have included significant wildfire devastation and joint foreign naval operations in the Arctic. The concept of simulating converging crises involving dual-use technologies across domains, while incorporating civil-military cooperation, aims to foster the development of related scenarios. Dual-use technologies support resilience and readiness in addressing these challenges. For example, artificial intelligence (AI) and uncrewed aerial systems (UAS) can be employed to monitor both the spread of wildfires and the naval maneuvers of foreign states in the Arctic.

The concept of converging crises involving dual-use technologies across various domains requires civil-military collaboration, raising several research questions that structure this discussion. First, how can scenario planning facilitate collaboration between civilians and the military when resources are scarce? When joint operations with limited resources involve civil-military collaboration, how do leaders clarify roles and responsibilities, foster trust, and conduct practical workshops to enhance operational effectiveness?

Further research questions include: What is the role of scenario context in determining how this level of collaboration is approached in practice? How can scenarios support the design of rapid response mechanisms to manage simultaneous, corresponding crises across domains involving dual-use technologies that require civil-military collaboration? How can these systems adapt to increasingly complex, converging crises that expose policy gaps in rapid response?

Scenario-based analysis provides a method for exploring response mechanisms for addressing corresponding crises. Simultaneous climate-enabled threats increasingly involve the use of dual-use technologies in both civilian and military contexts. Scenarios are developed using empirical observations, such as the simultaneous monitoring of wildfires and foreign naval maneuvers in the Arctic, based on real-world incidents.

In 2023, Canada experienced its worst wildfire season on record, with over 18 million hectares of land burned.¹ At the same time, the climate is warming, and the melting Arctic ice is making the region more navigable. Since 2022, Russia and China have conducted joint military exercises in the area.² In October 2024, China's Coast Guard entered the Arctic for the first time and has since participated in joint patrols with Russia.³

¹ Benjamin Shingler and Graeme Bruce, "Five Charts to Help Understand Canada's Record-Breaking Wildfire Season," *CBC News*, October 19, 2023, <https://www.cbc.ca/news/climate/wildfire-season-2023-wrap-1.6999005>.

² Sergey Sukhankin, "Sino-Russian Partnership in the Arctic and the Far East Reflect Joint Security Interests (Part One)," *Eurasia Daily Monitor* 21, no. 166 (The Jamestown Foundation, November 14, 2024), <https://jamestown.org/program/sino-russian-partnership-in-the-arctic-and-the-far-east-reflect-joint-security-interests-part-one/>.

³ Simone McCarthy, "China's Coast Guard Claims to Have Entered the Arctic Ocean for the First Time as It Ramps up Security Ties with Russia," *CNN*, October 3, 2024, <https://edition.cnn.com/2024/10/03/china/china-russia-coast-guard-arctic-ocean-intl-hnk/index.html>.

The monitoring of increasingly devastating wildfires and Arctic navigation by AI-powered UAS highlights the specific applications of emerging technologies in addressing climate-related challenges. This article argues that civil-military scenario planning must prioritize the integration of dual-use technologies, which are essential for responding to modern crises that involve complex emergencies spanning both civilian and military domains, thereby accounting for cross-domain issues. The simultaneous challenges posed by dual-use technologies play a significant role, and the article develops this argument by building a detailed scenario to highlight how the strategic use of dual-use technologies can enhance readiness and resource coordination under pressure.

Literature Review: Planning Dual-Use Scenarios Across Domains

Scenarios offer a highly versatile approach to planning rapid response mechanisms for addressing contemporary threats. Building scenarios involves “speculating about the uncertainty surrounding the future.”⁴ Specifically, the explanatory power of scenarios rests on the assumption that the “future can inform the decisions of the present,” supported by rational analysis, subjective judgements, and participant interactions within a dynamic, participatory approach.⁵

Scenarios facilitate discussion on key collaboration structures to plan strategically around the central concept in question – namely, converging crises that incorporate civil-military collaboration across domains and involve dual-use technologies. This analysis is designed to support scenario planners in developing policy and legal frameworks that ensure procedures are in place and personnel are trained in advance of simultaneous crises.

This discussion of converging crises shows how scenarios can be used to identify gaps in decision-making related to current procedures, while also highlighting weaknesses that may be overlooked during a crisis. The strengths of scenario planning, related to its focus on the structured interaction between simultaneous events—describing “multiple futures” where “several realizable or desirable futures are placed side by side”—are used to challenge an organization’s long-standing beliefs.⁶ Scenarios thus provide a means to coordinate and implement actions that improve organizational learning and decision-making.

When applied to dual-use technologies, scenario planning creates opportunities to overcome challenges arising from converging crises that involve limited resources across disciplines. A dual-use strategy supports “improved productiv-

⁴ Dana Mietzner and Guido Reger, “Advantages and Disadvantages of Scenario Approaches for Strategic Foresight,” *International Journal of Technology Intelligence and Planning* 1, no. 2 (2005): 220-239, 223, <https://doi.org/10.1504/IJTIP.2005.006516>.

⁵ Mietzner and Reger, “Advantages and Disadvantages of Scenario Approaches for Strategic Foresight,” 225.

⁶ Mietzner and Reger, “Advantages and Disadvantages of Scenario Approaches for Strategic Foresight,” 235.

ity and efficiency in armed forces, as well as effectiveness in the commercial industry with the minimum level of R&D spending.”⁷ Simulating civil-military collaboration tests decision-making to identify areas of cooperation and policy gaps, which can then be addressed to enhance readiness and resilience. Scenario-based training is most effective when it fosters collaboration, trust, and mutual understanding, engaging both civilian and military leaders in joint planning efforts.

Hedlund and Alvinus identified crisis management lessons from a case in Sweden, which revealed “significant shortcomings” within the crisis management systems, worsened by “governance and coordination ambiguities.”⁸ The authors emphasized the need to develop “clearer leadership and responsibility frameworks within civil and military defence entities.”⁹ Simulating an organization’s crisis management processes led to the identification of gaps that could be addressed by developing policy and legal frameworks to respond to climate-related crises across various domains.

Structured simulations of interconnected scenarios reveal unexpected frictions by exposing hidden policy gaps, triggering the proactive creation of standard operating procedures and legal response mechanisms. Narrative-driven scenarios enhance decision-making by focusing on specific areas where policy can be effectively developed. Scenario planning identifies gaps in decision-making and collaboration, informing the development of key policy response measures. Current applications involve utilizing prepared mechanisms and points of contact to address converging crises, with contingency preparations in place to address emerging threats. In cases where no pre-existing response measures exist, this approach reveals significant gaps in rapid response mechanisms, highlighting pressing areas of focus.

The Swedish case identified shortcomings in rapid crisis response decision-making, with a focus on civil-military collaboration, and demonstrates how lessons drawn from policy gaps can facilitate learning. Scenario planning can also uncover collaboration frictions, which can then be addressed by “examining regional civil-military exercises to determine their pedagogical design’s effectiveness in enhancing civil-military collaboration for crisis management and readiness.”¹⁰ Focusing on civil-military collaboration in scenario planning provides an

⁷ Bita Afshar and Kash Khorasani, “Dual Use Technology: Briefing Notes Emerging Technology and Military Application,” Briefing Notes (Montréal: Security Policy Nexus of Emerging Technologies, Concordia University, October 2020), 2, www.concordia.ca/content/dam/ginacody/research/spnet/Documents/BriefingNotes/EmergingTech-MilitaryApp/BN-19-Emerging-technology-and-military-application-Oct2020.pdf.

⁸ Erik Hedlund and Aida Alvinus, “Exercises for Developing Civil-Military Collaboration Capability: A Constructive Alignment Analysis,” *Journal of Contingencies and Crisis Management* 32, no. 2 (June 2024): e12575, 2, <https://doi.org/10.1111/1468-5973.12575>.

⁹ Hedlund and Alvinus, “Exercises for Developing Civil-Military Collaboration,” 2.

¹⁰ Hedlund and Alvinus, “Exercises for Developing Civil-Military Collaboration Capability,” 3.

approach to support policymakers in rapid response efforts involving both civilian and military actors.

Method: Scenario-Based Analysis on Dual-Use Technologies

This scenario-based analysis focuses on comparing distinct technologies used to address policy gaps and support the development of scenarios that challenge assumptions and identify areas for improvement, particularly in cases of unprecedented climate-related challenges, such as wildfires and the Arctic. The overlap in applications of dual-use technologies spans both civilian and military domains, allowing for the identification of institutional frictions that arise when responses prove inefficient in specific areas.

A comparative case study examines various technologies used to facilitate different stages of disaster management, focusing on AI-enabled wildfire response and Arctic-capable UAS for regional monitoring. Recent events provide examples of emerging technologies applied to address these challenges, offering valuable lessons to support innovative simulations and disaster response exercises. Scenario planning is applied as an analytic tool for AI-enabled wildfire response and Arctic-capable UAS monitoring.

Once the scenario background is established, an engaging setup provides details on the impact of these events on people, infrastructure, and services, thereby informing participants about affected populations and events.¹¹ A trigger incident initiates the crisis, involving two corresponding events that unfold chronologically as depicted in the timeline. Pre-arranged incident injects are used to force decision-makers to respond to exacerbating challenges.¹²

New threats are introduced to test the infrastructure and complicate responses. These sample injects can include various challenges such as targeted cyberattacks, misinformation, or media leaks, all of which complicate communication with the public regarding wildfires and Arctic developments. These initiatives are designed to prompt decision-makers to test their response mechanisms, deriving insights from challenges that require making decisions under stress and identifying governance gaps.

A simulated environment presents participants with challenges that require the adoption of careful and collaborative approaches to making informed decisions in unexpected situations.¹³ The lessons derived help inform policy guidelines, governance, and legal frameworks to support the preliminary development of response strategies across various domains, including those involving dual-use technologies and civil-military collaboration.

¹¹ Linda Austere, Guna Šnore, and Jon Sunderland, "Constructing a Table-Top Exercise (TTX)" (Riga, Latvia: NATO Strategic Communications Centre of Excellence, May 2022), 20, <https://stratcomcoe.org/publications/download/Constructing-a-Table-Top-Exercise-DIGITAL-FINAL-dccfe.pdf>.

¹² Austere, Šnore, and Sunderland, "Constructing a Table-Top Exercise," 24.

¹³ Austere, Šnore, and Sunderland, "Constructing a Table-Top Exercise," 24.

Results: Converging Crises and Policy Gap Innovation

This section provides comparative insights based on an overview of select technologies designed to support responses to the challenges of monitoring wildfires and foreign-state navigation in the Arctic. The occurrence of simultaneous crises and responses involving dual-use technologies offers crucial lessons on collaboration between civilian and military institutions. The following cases draw on unprecedented real-world examples, including AI-powered simulations to monitor and track wildfires and Arctic-capable UAS used to monitor Arctic activity.

AI-Powered Wildfire Management

Several platforms use AI for simulation, monitoring, early warning, and rapid response mechanisms in wildfire management. Selected tools are discussed here to provide context for populating scenarios with details that incorporate cutting-edge solutions to address these contemporary challenges.

The first platform, *SimFire*, was introduced by Tapley and colleagues to train and educate personnel through simulated wildfires designed to test firefighters and assess their effectiveness.¹⁴ The fire projection simulator generates wildfire scenarios to model fire behavior and support training on effective mitigation strategies. Scenario planners can simulate different types of fires and observe how they are extinguished, customizing training to the specific geography of the simulated setting. This platform requires significant data on weather, wildlife, and landscapes to support professional crisis planning with related support units.

SimFire features realistic and customizable training scenarios that facilitate multi-agency coordination and collaboration. The collected data is used to support after-action reviews and train professionals in decision-making under pressure. *SimFire* relies on specialized simulation software, including *SimHarness*, a Python-based repository that provides an API to “move agents around the simulated environment and interact with it by placing mitigations ... such as firelines to limit the spread of the fire within the area.”¹⁵ *SimHarness* allows users to create customized goals, with some scenarios prioritizing “ending the fire as quickly as possible, while others may focus more on limiting the fire spread to specific areas.”¹⁶

Real-world data—including regional characteristics, vegetation types, and weather patterns—inform participants through context-specific simulations based on real cases. These wildfire scenarios enhance realism and foster collaboration among participants, demonstrating the development of hyper-realistic, data-heavy simulations. *SimFire* uses AI to support training, policy development,

¹⁴ Alexander Tapley et al., “Reinforcement Learning for Wildfire Mitigation in Simulated Disaster Environments,” in *Climate Change AI* (NeurIPS 2023 Workshop on Tackling Climate Change with Machine Learning, Climate Change AI, 2023), www.climatechange.ai/papers/neurips2023/31.

¹⁵ Tapley et al., “Reinforcement Learning for Wildfire Mitigation,” 3.

¹⁶ Tapley et al., “Reinforcement Learning for Wildfire Mitigation,” 3.

and the establishment of preliminary agreements between organizations. However, the platform is not well-suited for actual monitoring or in-field response due to its significant data requirements.

The second platform, *ALERT Wildfire*, is an AI-powered system that monitors fires and alerts key stakeholders when they are detected. The technology relies on AI object recognition, high-definition wide-angle cameras, and solar power to quickly detect and locate fires. The AI model analyzes “360-degree panoramic images at a rate of one image per minute... enabling the early detection of emerging fires.”¹⁷

This system requires a stable network connection and accurate data, which makes maintenance challenging during nighttime and periods of extreme smoke or fog. The platform is civilian-owned and operated, and can be embedded in both civilian and military settings to share information and participate in joint monitoring activities. *ALERT Wildfire* requires infrastructure that works seamlessly, as AI-powered early fire warning systems capture images from the ground to provide actionable information on the locations and movements of wildfires.

Together, *SimFire* and *ALERT Wildfire* offer distinct approaches to simulation-based training and active monitoring of climate-enabled challenges. *SimFire* trains professionals to enhance wildfire management, while *ALERT Wildfire* provides early warning and rapid response coordination. Robust infrastructure supports solar-powered systems in remote locations, highlighting the need for better integration into more extensive disaster response networks.

SimFire incorporates first-response training data to enable teams to drill challenging simulations, including community-led readiness exercises and multi-agency emergency wildfire response drills. These scenarios initiate discussions that can lead to the development of appropriate response mechanisms and legal frameworks well in advance of converging crises. *ALERT Wildfire* utilizes real-time data enhancements to improve operational readiness. *SimFire* enhances capacity and resilience through training, leveraging AI-powered tools that support scenario-based approaches with a focus on pre-crisis simulations and active wildfire monitoring.

SimFire provides first responders with a dynamic and adaptable training environment that simulates various wildfire scenarios. Professionals learn how to respond effectively by designing policy and legal frameworks that support civil-military collaboration in response to these scenarios. The platform must accurately reflect the real world, remaining highly dependent on data availability to simulate crises and build response strategies, which demonstrates a crucial challenge for its effectiveness.

AI-powered uncrewed aerial systems (UAS) are designed for multiple roles in wildfire management. This discussion focuses on uncrewed aerial systems rather than uncrewed aerial vehicles (UAVs), as UAS represent a broader framework

¹⁷ Leendert Remmelzwaal, “An AI-Based Early Fire Detection System Utilizing HD Cameras and Real-Time Image Analysis,” *Artificial Intelligence and Applications* (2023), 3, <https://doi.org/10.47852/bonviewAIA3202975>.

incorporating the full range of capabilities beyond the aircraft itself. UAVs focus solely on the vehicle, whereas UAS integrate aircraft, ground control, and communication systems. For this reason, the article emphasizes UAS as the primary framework.

UAS have been designed to combat wildfires through suppression, reconnaissance, tracking, and search and rescue operations. Ausonio and co-workers demonstrated the ability of a drone system to create the “rain effect,” where “small quantities of firefighting liquids” are released over the fire to extinguish it.¹⁸ This swarm strategy resembles the function of domestic or industrial fire sprinklers. UAS swarming is distinct from traditional approaches that involve “dropping the liquid in a concentrated method.”¹⁹ Increased accuracy enables disaster risk managers to access more relevant and accurate data, reducing uncertainty in decision-making and informing real-time damage assessments.

AI-powered early warning systems (EWS) rely on various approaches that integrate with systems involved in “hazard monitoring, forecasting and prediction, disaster risk assessment, [and] communication and preparedness activities.”²⁰ All of these approaches aim to intervene at crucial moments to reduce disaster risks, while also acknowledging the difficulty of predicting impacts on local environments and social systems.

AI-powered EWS must remain accurate even where weather and hazard data are insufficient. This major challenge relates to “concurrent, compounding, and cascading events, hampered by the lack of connection across the various thematic, institutional, and regional silos.”²¹ Addressing this challenge requires forecasts across systems when interdisciplinary models of integration are lacking, which are crucial for both identifying connections and approaching the challenge effectively.

Arctic-Capable UAS

The operation of Arctic-capable UAS in harsh northern weather conditions involves navigating melting ice and enhancing regional monitoring of foreign naval activity. This section focuses on three UAVs capable of long-endurance aerial surveillance and mapping for intelligence, surveillance, and reconnaissance (ISR) missions in the Arctic.

The MQ-4C Triton, RQ-4 Global Hawk, and MQ-9 Reaper exemplify UAVs that have overcome many of the challenges associated with aerial operations in harsh

¹⁸ Elena Ausonio, Patrizia Bagnerini, and Marco Ghio, “Drone Swarms in Fire Suppression Activities: Conceptual Framework,” *Drones* 5, no. 1 (March 7, 2021), article 17, 5, <https://doi.org/10.3390/drones5010017>.

¹⁹ Ausonio, Bagnerini, and Ghio, “Drone Swarms in Fire Suppression Activities,” 5.

²⁰ Markus Reichstein et al., “Early Warning of Complex Climate Risk with Integrated Artificial Intelligence,” *Nature Communications* 16, no. 1 (March 15, 2025), article 2564, 2, <https://doi.org/10.1038/s41467-025-57640-w>.

²¹ Reichstein et al., “Early Warning of Complex Climate Risk,” 4.

northern climates. Environmental constraints include icing hazards, satellite coverage gaps, limited launch and recovery locations, sensor limitations, and reduced battery performance caused by extreme cold.

Arctic weather poses several challenges for UAVs, which are required to monitor isolated areas and therefore demand specialized sensors and skills. Cold temperatures and icing conditions create significant operational risks, while remote locations complicate deployment and recovery. Additional environmental difficulties include freezing rain, heavy and gusty winds, dense clouds, ice fog, and prolonged periods of low temperatures.²²

The MQ-4C Triton is equipped with de-icing systems that were successfully tested in early 2023 and is capable of operating for over 24 hours at altitudes above 50,000 feet.²³ The Triton can effectively operate in Arctic conditions, performing in adverse weather and using its de-icing capabilities, which make it a highly reliable aircraft.²⁴ Test flights over the Arctic Ocean demonstrate how UAS designers have addressed the critical challenge of de-icing for Arctic operations.²⁵

Two additional examples of Arctic-capable UAVs highlight their unique capabilities. The RQ-4 Global Hawk can remain airborne for up to 34 hours and is equipped with sensors for reconnaissance as well as air and maritime surveillance.²⁶ The MQ-9 Reaper can provide ISR for over 27 hours and has been employed to monitor Russian activity in the Arctic.²⁷

One central difference between these systems is that, unlike the MQ-4C Triton and the RQ-4 Global Hawk, the MQ-9 Reaper can also conduct airstrikes, demonstrating a significant dual-use capability that combines monitoring and combat operations. The warming summer months, accompanied by melting Arctic ice, suggest that the region will become more navigable and contested. Arctic-capable UAS will therefore play an increasingly important role in monitoring maritime trade routes and navigation.

²² Vadim Kramar, "UAS (Drone) Arctic Challenges – Next Steps," in *Proceedings of the 25th Conference of FRUCT Association*, Helsinki, Finland, November 5-8, 2019, <https://old.fruct.org/publications/acm25/files/Kra.pdf>.

²³ "US Navy's MQ-4C UAS Undergoes First Anti-Icing Test," *Naval Technology*, January 27, 2023, <https://www.naval-technology.com/news/us-mq4c-anti-icing-test/>.

²⁴ Northrop Grumman, "Northrop Grumman Demonstrates MQ-4C Triton Navigation Systems over the Arctic Ocean," *Defence Industry Europe*, September 19, 2024, <https://defence-industry.eu/northrop-grumman-demonstrates-mq-4c-triton-navigation-systems-over-the-arctic-ocean/>.

²⁵ Unshin Lee Harpley, "Drones Take on the Arctic," *Air & Space Forces Magazine*, November 1, 2024, <https://www.airandspaceforces.com/article/drones-take-on-the-arctic/>.

²⁶ Harpley, "Drones Take on the Arctic."

²⁷ Ryan Chan, "US Navy Spy Drone Flies Deep into Arctic Amid Russia Threat," *Newsweek*, September 20, 2024, <https://www.newsweek.com/us-news-navy-spy-drone-flies-deep-arctic-amid-russia-threat-1956793>.

In recent years, Russia and China have conducted joint naval operations in the Arctic. Evidence of further collaboration between the two countries increased significantly following Russia's February 2022 invasion of Ukraine. However, analysts have also observed China hacking into Russian companies and government agencies to obtain military secrets dating back to at least May 2022, highlighting the limitations of joint operations developing into a formal military cooperation agreement.²⁸

Rácz and Hrytsenko note that climate change has opened "new maritime routes and resource frontiers," suggesting that the region will become "an arena where geopolitics, security, and great-power competition converge."²⁹ Joint operations between Russia and China have increased, but have not amounted to a formal military agreement due to divergent self-interests in the region. Continued cooperation, however, could lead to "joint-use military and logistic bases" in the Arctic, supporting "naval operations, strategic aviation, and even submarine deployments."³⁰

Regional competition among NATO, Russia, and China is likely to intensify, increasing the need for enhanced collaboration to address concurrent crises involving emerging technologies across multiple domains. For instance, Russia and China have used "low-intensity denial operations" to target critical infrastructure in several cases between 2023 and 2025.³¹ In October 2023, the Chinese ship *Newnew Polar Bear*, operated by a Russian crew, damaged a gas pipeline and data cables while dragging its anchor in the Baltic Sea. China admitted responsibility for this incident in August 2024, "claiming it was an accident."³²

In November 2024, another Chinese ship, *Yi Peng 3*, commanded by a Russian captain, cut another cable on the Baltic Sea floor.³³ The most recent related incident occurred in January 2025, when a Chinese cargo ship damaged underwater cables off the coast of Taiwan. No evidence has been published to suggest cooperation between Russia and China in these incidents, which caused significant damage to critical infrastructure.

²⁸ Megha Rajagopalan, "China Unleashes Hackers Against Its Friend Russia, Seeking War Secrets," *The New York Times*, June 19, 2025, <https://www.nytimes.com/2025/06/19/world/europe/china-hackers-russia-war-ukraine.html>.

²⁹ András Rácz and Alina Hrytsenko, "Partnership Short of Alliance: Military Cooperation Between Russia and China," *Insights & Analysis: Comprehensive Report*, Centre for European Policy Analysis, June 16, 2025, <https://cepa.org/comprehensive-reports/partnership-short-of-alliance-military-cooperation-between-russia-and-china/>.

³⁰ Rácz and Hrytsenko, "Partnership Short of Alliance."

³¹ Rácz and Hrytsenko, "Partnership Short of Alliance."

³² "China Admits Container Ship Newnew Polar Bear Damaged Undersea Pipeline," *ERR News*, August 12, 2024, <https://news.err.ee/1609422658/china-admits-container-ship-newnew-polar-bear-damaged-undersea-gas-pipeline>.

³³ Rácz and Hrytsenko, "Partnership Short of Alliance."

Discussion: Strategic Insights from Cross-Domain Threats

This discussion presents clear takeaways that address the research questions and provide feedback on insights to reinforce the analytical value of scenario building. A sample scenario illustrates the challenge of simultaneous cross-domain, dual-use crises that involve limited resources and require collaboration between civilian and military decision-makers.

Lessons learned from this focus on simultaneous cross-domain challenges are illustrated by wildfires and Arctic navigation, both of which involve civilian and military collaboration on dual-use technologies – such as those used in wildfire management and in monitoring foreign navigation. Real-world events inspire scenario leaders to use this background information to inject relevant empirical observations, which are fundamentally interdisciplinary and interoperable.

Recent precedent-setting wildfires in Canada and joint naval patrols by Russia and China in the Arctic provide scenarios for analysis. The focus is on the concept of responding to simultaneous cross-domain crises involving dual-use technologies and civil-military collaboration. Such cross-domain challenges are inherently interdisciplinary, requiring collaboration among key stakeholders, training to close policy gaps, and measures to ensure effective responses when crises strike.

In recent years, misinformation has complicated wildfire responses by obscuring official communications and disseminating false claims, including conspiracy theories and misleading narratives about government actions. These climate-related challenges are exacerbated by targeted misinformation, underscoring the interdisciplinary nature of such threats and necessitating interoperability to bridge decision-making gaps among stakeholders across diverse domains.

In 2023, conspiracy theories surrounding Canadian wildfires and government responses highlighted the need for an interdisciplinary approach to prevent internal and political divisions from being exploited.³⁴ Misinformation also disrupted wildfire rapid response efforts in 2023, with reports of the “physical disruption of emergency response... including a confrontation with authorities on an evacuation route, [and] a decision to withdraw firefighters defending communities.”³⁵

In 2024, false information was disseminated during the wildfires in Jasper, Alberta, prompting authorities to release communications warning that misinformation could inhibit response and recovery efforts. Authorities urged the public to rely only on official sources to “stay informed and prevent the spread

³⁴ Hina Alam, “Conspiracy Theories Swirl around Wildfires amid Record Season in Canada,” *Global News*, August 25, 2023, <https://globalnews.ca/news/9919194/canada-wildfires-conspiracy-theories/>.

³⁵ Chris Russill et al., “Flame Wars: Misinformation and Wildfire in Canada’s Climate Conversation” (Re.Climate, Centre for Media, Technology and Democracy, and Climate Action Against Disinformation, 2024), 6, <https://reclimate.ca/wp-content/uploads/2024/06/Re.Climate-Report-Wildfire-Misinformation-2024.pdf>.

of misinformation.”³⁶ In 2025, social media algorithms further amplified false information about wildfires, eroding trust in disaster response and official sources.³⁷

NATO’s 2024 *Climate Change and Security Impact Assessment* outlined Russian involvement in spreading disinformation online to target climate and energy issues in order to divide public opinion.³⁸ Kremlin-backed actors promoted “climate denialism” during other wildfire emergencies, such as in Hawaii in 2023.³⁹ These false narratives sought to “draw a binary picture in which the West appears as the aggressor, while Russia and its partners pose as defenders of an equitable international order.”⁴⁰ Such narratives frame NATO as a destabilizing force and Russia as a defender of regional stability. When Russia and China’s joint Arctic operations are presented in this manner, seemingly innocuous activities can provide cover for destructive actions targeting critical infrastructure.

Converging crises are a unique phenomenon that challenges decision-makers to address dual-use coordination mechanisms across various domains. AI-powered UAS offer response capabilities that necessitate collaboration between civilian and military institutions. This focus on cross-domain integration aims to understand how governance mechanisms adapt in response to challenges that span multiple domains. A structured approach provides legitimacy to the scenario’s cross-domain and dual-use design, helping to identify and close decision-making gaps that hinder rapid response mechanisms in real-world crises.

Sample Scenario Example

Setup: This discussion concludes with an outline of a sample scenario, providing background information and sample injects to support policymakers in adapting rapid response capabilities to the unique challenge of converging crises. In late summer 2026, extremely hot temperatures trigger two simultaneous events. An active wildfire season sets new records for the number of landmasses burning in Northern Alberta.

³⁶ Government of Canada, Parks Canada Agency, “The 2024 Jasper Wildfire: Frequently Asked Questions (FAQ) about the Incident, Response and Recovery,” May 8, 2025, <https://parks.canada.ca/pn-np/ab/jasper/visit/feu-alert-fire/feudeforet-jasper-wildfire/questions>.

³⁷ Natasha Bulowski, “How to Spot Bad Information This Wildfire Season,” *Canada’s National Observer*, June 3, 2025, <https://www.nationalobserver.com/2025/06/03/news/spot-bad-information-disinformation-misinformation-wildfire-season>.

³⁸ Jens Stoltenberg, *NATO Climate Change and Security Impact Assessment: The Secretary General’s Report* (NATO, 2024), https://www.nato.int/nato_static_fl2014/assets/pdf/2024/7/pdf/240709-Climate-Security-Impact.pdf.

³⁹ Stoltenberg, *NATO Climate Change and Security Impact Assessment*, 27.

⁴⁰ Mathieu Landriault and Julie Renaud, “The Narrative War in the Arctic: Between Russian Disinformation and International Rivalries,” Policy Brief, Network for Strategic Analysis, January 14, 2025, <https://ras-nsa.ca/the-narratives-war-in-the-arctic-between-russian-disinformation-and-international-rivalries/>.

Background: An unprecedented amount of Arctic ice has melted, leading to an increasingly navigable North. This has resulted in joint naval operations by Russia and China. AI-powered UAS are deployed to simultaneously track the fast-spreading wildfires and the joint military navigation in the Canadian Arctic. One Arctic vessel first appeared without a transponder and was carrying research equipment. It entered Canadian Arctic waters, coming dangerously close to critical infrastructure and navigating in strange and suspicious patterns.

Response 1: AI-powered UAS are deployed to track military navigation in the Canadian Arctic while also monitoring the fast-spreading wildfires. These systems are a limited resource required for simultaneous deployment in Northern Alberta and the Arctic. Asset deployment follows a predetermined chain of command to allocate resources and manage how this escalation of duties should proceed.

Injects: While these processes are underway, several other related incidents further complicate decision-making. These injects are introduced to amplify stress on decision-makers and may involve interdisciplinary challenges such as media leaks, cyberattacks, and targeted disinformation. The deployment of UAS is leaked to Canadian media, sparking public panic in the wildfire zone. The story is then amplified and spread across social media by a loose network of foreign propaganda outlets, framing UAS footage as evidence that Canada is militarizing the Arctic. A cyberattack disrupts communications between authorities and the public, complicating efforts to verify claims about the UAS footage and counter the militarization narrative. Authorities struggle to control the narrative, while frustrated decision-makers continue monitoring and adapting to these converging crises.

Response 2: After some time, communications are restored. Authorities release UAS footage of the Russia-China joint naval operation in the Arctic, explaining the reason for the deployment. Footage of the wildfires, however, remains at the top of the news cycle.

Review: At this point, the simulation concludes. Time is taken to review, respond, and identify policy gaps that further engagement can address. The conclusion of the scenario provides an opportunity for participants to assess these gaps and extract lessons learned to prepare decision-makers better. Given the general nature of this scenario outline, it is difficult to predict the exact requirements. However, the events related to *Response 1* will be crucial in determining whether policy gaps persist. At that stage, either clear procedures are already in place to address this unique situation, or there are none, making the identification of policy gaps the central focus of the review.

Conclusion: Scenario-Based Innovation

This scenario-based analysis of dual-use technologies enhances civil-military coordination in response to simultaneous climate-security threats. The scenario-building exercise was designed to simulate a converging crisis involving climate-

related wildfires and Arctic incursions, applying dual-use technologies to evaluate real-world interoperability and decision-making. For civil-military coordination to succeed during simultaneous climate-security crises, dual-use technology must be integrated to adapt to different scenarios, with strict adherence to governance protocols.

This analysis focused on cross-domain, dual-use, converging crises amplified by climate-related challenges, revealing key findings that provide crucial lessons for improving scenario planning. These lessons can enhance civil-military preparedness and foster interoperability in future crises.

Scenario-based approaches can also uncover systemic weaknesses in data-sharing protocols, escalation chains, and decision-making structures for civil-military collaboration during cross-domain emergencies. Scenarios can help identify policy gaps and support innovation in overcoming challenges, as illustrated by examples such as AI-driven wildfire management and Arctic-capable UAVs.

Simulations further enable the identification and mitigation of policy gaps in institutional readiness and resilience across civil-military boundaries. Notably, the successful application of AI and UAS technologies does not, by itself, guarantee resilience. While these tools enhance situational awareness and rapid response, they still require robust pre-crisis agreements among key stakeholders.

Preparatory measures should therefore include the development of shared operating documents and legal frameworks to ensure effective cross-domain functioning and rapid response mechanisms, thereby fostering necessary collaboration among the involved agencies. These observations carry significant policy and training implications, with scenarios offering ideal approaches for training and education to foster situational awareness and build capacity. Such scenarios must remain a core component of civil-military readiness.

Future research will further contribute to scenario-based learning, supporting long-term institutional development and effective governance of dual-use technologies. Additional research questions include: Who owns the technology, and who deploys it? What are the next steps in addressing policy gaps identified in these scenarios? Once a simulation and post-scenario session are concluded, how are these gaps acted upon? What concrete actions are required to close them? As climate-related geopolitical tensions escalate in remote regions such as the Arctic, integrated scenario-based planning is no longer optional – it is a strategic imperative.

Disclaimer

The opinions, findings, conclusions, and recommendations expressed in this publication are those of the author and do not necessarily reflect the official policy or position of the Partnership for Peace Consortium, its participating institutions, or any governmental or international organizations affiliated with its governance structure.

About the Author

Ryan Atkinson, PhD, is a postdoctoral fellow at Carleton University, supported by the Canadian Defence and Security Network (CDSN). His research focuses on emerging technologies and defence policy. Ryan's career combines in-depth academic knowledge with hands-on experience in defence and security, including work with the international staff at the North Atlantic Treaty Organization (NATO). He previously managed the cybersecurity program for the NATO Association of Canada, where he focused on enhancing awareness and resilience initiatives. Additionally, Ryan has conducted cybersecurity assessments as a consultant for various organizations. He holds a Ph.D. in Political Science from Western University and an M.A. in the same field from the University of Toronto.
E-mail: ryanatkinson@cunet.carleton.ca.

Bibliography

- Shingler, Benjamin, and Graeme Bruce, "Five Charts to Help Understand Canada's Record-Breaking Wildfire Season," *CBC News*, October 19, 2023, www.cbc.ca/news/climate/wildfire-season-2023-wrap-1.6999005.
- Sukhankin, Sergey, "Sino-Russian Partnership in the Arctic and the Far East Reflect Joint Security Interests (Part One)," *Eurasia Daily Monitor* 21, no. 166 (The Jamestown Foundation, November 14, 2024), <https://jamestown.org/program/sino-russian-partnership-in-the-arctic-and-the-far-east-reflect-joint-security-interests-part-one/>.
- McCarthy, Simone, "China's Coast Guard Claims to Have Entered the Arctic Ocean for the First Time as It Ramps up Security Ties with Russia," *CNN*, October 3, 2024, <https://edition.cnn.com/2024/10/03/china/china-russia-coast-guard-arctic-ocean-intl-hnk/index.html>.
- Mietzner, Dana, and Guido Reger, "Advantages and Disadvantages of Scenario Approaches for Strategic Foresight," *International Journal of Technology Intelligence and Planning* 1, no. 2 (2005): 220-239, 223, <https://doi.org/10.1504/IJTIP.2005.006516>.
- Afshar, Bitā, and Kash Khorasani, "Dual Use Technology: Briefing Notes Emerging Technology and Military Application," *Briefing Notes* (Montréal: Security Policy Nexus of Emerging Technologies, Concordia University, October 2020), 2, <https://www.concordia.ca/content/dam/ginacody/research/spnet/Documents/BriefingNotes/EmergingTech-MilitaryApp/BN-19-Emerging-technology-and-military-application-Oct2020.pdf>.
- Hedlund, Erik, and Aida Alvinus, "Exercises for Developing Civil-Military Collaboration Capability: A Constructive Alignment Analysis," *Journal of Contingencies and Crisis Management* 32, no. 2 (June 2024): e12575, <https://doi.org/10.1111/1468-5973.12575>.
- Austere, Linda, Guna Šnore, and Jon Sunderland, "Constructing a Table-Top Exercise (TTX)" (Riga, Latvia: NATO Strategic Communications Centre of Excellence, May 2022), 20, <https://stratcomcoe.org/publications/download/Constructing-a-Table-Top-Exercise-DIGITAL-FINAL-dccfe.pdf>.
- Tapley, Alexander, et al., "Reinforcement Learning for Wildfire Mitigation in Simulated Disaster Environments," in *Climate Change AI (NeurIPS 2023 Workshop on Tackling Climate Change with Machine Learning, Climate Change AI, 2023)*, <https://www.climatechange.ai/papers/neurips2023/31>.
- Rommelzwaal, Leendert, "An AI-Based Early Fire Detection System Utilizing HD Cameras and Real-Time Image Analysis," *Artificial Intelligence and Applications* (2023), 3, <https://doi.org/10.47852/bonviewAIA3202975>.

- Ausonio, Elena, Patrizia Bagnerini, and Marco Ghio, "Drone Swarms in Fire Suppression Activities: Conceptual Framework," *Drones* 5, no. 1 (March 7, 2021), article 17, <https://doi.org/10.3390/drones5010017>.
- Reichstein, Markus, et al., "Early Warning of Complex Climate Risk with Integrated Artificial Intelligence," *Nature Communications* 16, no. 1 (March 15, 2025), article 2564, <https://doi.org/10.1038/s41467-025-57640-w>.
- Kramar, Vadim, "UAS (Drone) Arctic Challenges – Next Steps," in *Proceedings of the 25th Conference of FRUCT Association*, Helsinki, Finland, November 5-8, 2019, <https://old.fruct.org/publications/acm25/files/Kra.pdf>.
- "US Navy's MQ-4C UAS Undergoes First Anti-Icing Test," *Naval Technology*, January 27, 2023, <https://www.naval-technology.com/news/us-mq4c-anti-icing-test/>.
- Northrop Grumman, "Northrop Grumman Demonstrates MQ-4C Triton Navigation Systems over the Arctic Ocean," Defence Industry Europe, September 19, 2024, <https://defence-industry.eu/northrop-grumman-demonstrates-mq-4c-triton-navigation-systems-over-the-arctic-ocean/>.
- Harpley, Unshin Lee, "Drones Take on the Arctic," *Air & Space Forces Magazine*, November 1, 2024, <https://www.airandspaceforces.com/article/drones-take-on-the-arctic/>.
- Chan, Ryan, "US Navy Spy Drone Flies Deep into Arctic Amid Russia Threat," *Newsweek*, September 20, 2024, <https://www.newsweek.com/us-news-navy-spy-drone-flies-deep-arctic-amid-russia-threat-1956793>.
- Rajagopalan, Megha, "China Unleashes Hackers Against Its Friend Russia, Seeking War Secrets," *The New York Times*, June 19, 2025, <https://www.nytimes.com/2025/06/19/world/europe/china-hackers-russia-war-ukraine.html>.
- Rácz, András, and Alina Hrytsenko, "Partnership Short of Alliance: Military Cooperation Between Russia and China," *Insights & Analysis: Comprehensive Report*, Centre for European Policy Analysis, June 16, 2025, <https://cepa.org/comprehensive-reports/partnership-short-of-alliance-military-cooperation-between-russia-and-china/>.
- "China Admits Container Ship Newnew Polar Bear Damaged Undersea Pipeline," *ERR News*, August 12, 2024, <https://news.err.ee/1609422658/china-admits-container-ship-newnew-polar-bear-damaged-undersea-gas-pipeline>.
- Alam, Hina, "Conspiracy Theories Swirl around Wildfires amid Record Season in Canada," *Global News*, August 25, 2023, <https://globalnews.ca/news/9919194/canada-wildfires-conspiracy-theories/>.
- Russill, Chris, et al., "Flame Wars: Misinformation and Wildfire in Canada's Climate Conversation" (Re.Climate, Centre for Media, Technology and Democracy, and Climate Action Against Disinformation, 2024), <https://reclimate.ca/wp-content/uploads/2024/06/Re.Climate-Report-Wildfire-Misinformation-2024.pdf>.

Government of Canada, Parks Canada Agency, "The 2024 Jasper Wildfire: Frequently Asked Questions (FAQ) about the Incident, Response and Recovery," May 8, 2025, <https://parks.canada.ca/pn-np/ab/jasper/visit/feu-alert-fire/feudeforet-jasper-wildfire/questions>.

Bulowski, Natasha, "How to Spot Bad Information This Wildfire Season," *Canada's National Observer*, June 3, 2025, <https://www.nationalobserver.com/2025/06/03/news/spot-bad-information-disinformation-misinformation-wildfire-season>.

Stoltenberg, Jens, *NATO Climate Change and Security Impact Assessment: The Secretary General's Report* (NATO, 2024), https://www.nato.int/nato_static_fl2014/assets/pdf/2024/7/pdf/240709-Climate-Security-Impact.pdf.

Landriault, Mathieu, and Julie Renaud, "The Narrative War in the Arctic: Between Russian Disinformation and International Rivalries," *Policy Brief*, Network for Strategic Analysis, January 14, 2025, <https://ras-nsa.ca/the-narratives-war-in-the-arctic-between-russian-disinformation-and-international-rivalries/>.