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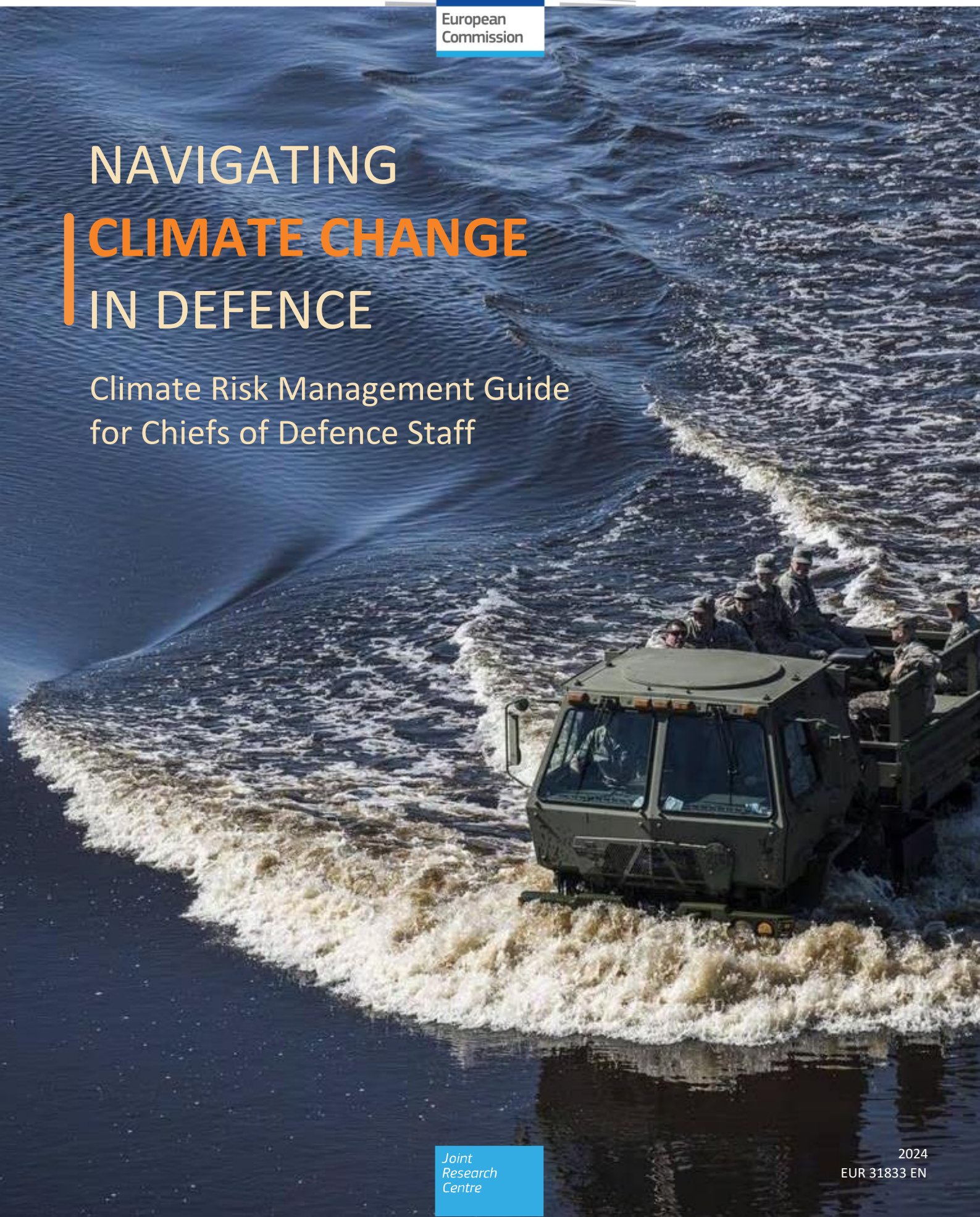
NAVIGATING CLIMATE CHANGE IN DEFENCE

Climate Risk Management Guide for Chiefs of Defence Staff



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NAVIGATING **CLIMATE CHANGE** IN DEFENCE

Climate Risk Management Guide for Chiefs of Defence Staff

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Abstract

Undertaking climate action and implementing robust climate risk management in the defence sector has become indispensable. Climate change poses significant risks to the defence workforce, both military and civilian. It threatens infrastructures, assets and capabilities, as well as communities in the vicinity of military installations, which provide the civilian services the armed forces depend upon. Climate change is also reshaping military missions and operations. Manifesting itself as severe weather and climate events, in changing operating conditions and amplified security issues, climate change affects operational readiness and effectiveness. Moreover, it permeates supply chains and resource availability and disrupts critical infrastructure, which indirectly has major repercussions for the continuity and sustainability of the armed forces. Proactively embracing climate risk management not only helps to prevent or reduce the potential for harm, damage and loss, but also cultivates adaptability and resilience that ensure acceptable functionality, especially during crises. This climate risk management guide supports Chiefs of Defence Staff, the highest-ranking military officers in the armed forces, in incorporating climate change considerations into their planning and budgeting, while enhancing climate resilience within their organisations. By bridging the gap between climate adaptation and risk management, they align their strategies with the European Union’s acknowledgement of the climate change-security nexus, enabling them to navigate climate uncertainty effectively. In this regard, the guide also includes a checklist to assist Chiefs of Defence Staff in assessing their organisation’s status in climate risk management. Utilising these insights at the national level strengthens the EU's ability to tackle climate challenges in defence, enhancing adaptability, energy resilience and autonomy.

Foreword

Our world is experiencing the escalating impacts of climate change, evident through extreme weather events, rising sea levels and shifting geopolitical landscapes. These phenomena have significant effects on economies, resources and global prosperity. They are major catalysts for conflict and instability, calling for a more evolved and comprehensive response. Consequently, we must view climate change not merely as an environmental issue but also as a profound security concern that reshapes the operational landscape of our armed forces. Recognising the interplay between environmental change and global security is crucial for fostering a resilient and sustainable future. The EU has long acknowledged the intricate link between climate change, security and defence, emphasising the need for strategic adaptation and energy resilience.

This *Climate Risk Management Guide for Chiefs of Defence Staff* is a comprehensive roadmap to navigate this complex topic. It is essential for addressing the many challenges posed to defence by climate change, ensuring that our armed forces, capabilities and installations remain resilient, adaptable and effective in the face of evolving climate risk. As our armed forces are often at the forefront of responding to climate-induced crises, this guide offers a solid framework to ensure they are equipped with the necessary knowledge, strategies, tools and foresight to address climate risk. It underscores the importance of leadership, innovation, risk management culture and collaboration in driving this transformation. It gives insights into incorporating climate risk management into the core of defence processes, from decision-making to budgeting and military planning.

The *European Union Military Committee*, the highest military body within the *Council of the European Union*, steers and coordinates the efforts of EU Member States in conflict prevention and crisis management. The principles and actions outlined in this guide align with our mission to oversee all military activities within the EU framework. It marks a significant step towards enhancing the military dimension of crisis management, developing capabilities and fostering cooperation with partners. I commend the continuous support of EU bodies such as the *European Commission Directorate-General Joint Research Centre* and the *European Defence Agency* in advancing the defence energy transition and climate change adaptation.

The guide's recommendations and checklist serve as a call to action for all Chiefs of Defence Staff to lead with courage and commitment in an era marked by unprecedented environmental challenges. Climate change is not only a strategic challenge for societies but also for militaries. By embracing the proposed actions in this guide, we can ensure that our forces remain robust, resilient and prepared to face today's and tomorrow's challenges.

General Robert BRIEGER
Chairman of the
European Union Military Committee

Executive Summary

Climate change presents a significant threat to the defence workforce, military infrastructure, assets and capabilities, missions and operations. The impacts of climate change may lead to the destruction or impairment of military assets, pose significant operational challenges and endanger the safety and well-being of staff. Growing concern extends to critical infrastructure as their disruption can cascade to military installations, jeopardising operational readiness and effectiveness. Proactively addressing climate change via risk management and implementing tailored risk reduction and resilience measures will decrease future financial losses, preserve military capability and ensure operational effectiveness and sustainability. This climate risk management guide aims to support Chiefs of Defence Staff in tackling the challenges posed by climate change and it provides a checklist to gauge the status of climate risk management in their organisation.

Policy context

The current EU policy landscape underscores the importance of the climate-security nexus and the urgency to take action on climate change, by both reducing greenhouse gas (GHG) emissions and strengthening climate resilience. This guide contributes to several EU policies, most importantly to the 2022 *Strategic Compass for Security and Defence*, which clearly identifies climate change as a threat multiplier that needs to be addressed by strengthening resilience and achieving net-zero GHG emissions. In this regard, the Strategic Compass requires the EU Member States to draw up national defence strategies to prepare the armed forces for climate change. More recently, the 2023 *Joint Communication on the climate-security nexus*, which complements the 2020 *EU Climate Change and Defence Roadmap*, lays down EU-level actions to address climate change and environmental degradation in peace, security and defence. Finally, the *Critical Entities Resilience Directive* of 2023, which strengthens the resilience of critical entities – a key factor in managing climate risk – acknowledges the interdependency of critical infrastructure, which is of great relevance to defence. It complements the *EU Climate Adaptation Strategy*, which aims for a climate-resilient society by 2050.

Key conclusions and recommendations

In a time marked by intensifying climate hazards and rapidly changing operational conditions, the capacity to effectively manage climate risk has never been more crucial. The recommendations outlined in this guide provide a comprehensive roadmap for Chiefs of Defence Staff to successfully navigate the intricate landscape of climate risk management. By embracing climate action, simultaneously directing efforts towards reducing GHG emissions while fostering a risk culture, and integrating climate considerations across their organisation, Chiefs of Defence Staff can strengthen resilience and seize a strategic advantage. As climate risk management aligns with strategic objectives and becomes seamlessly integrated into organisational processes, Chiefs of Defence Staff lay the foundation for increased autonomy, security and sustainability. In driving their staff towards climate action, and by using green procurement as a catalyst of change in the defence industry, Chiefs of Defence Staff exert a transformative influence, forging a path towards a more climate-resilient force.

In response to the urgency of climate change, the following recommendations are put forward for Chiefs of Defence Staff to implement climate risk management across their organisation:

- **Align national defence strategies on climate change with the EU's objectives** for climate change adaptation, energy resilience and net-zero GHG emissions by 2050.
- **Harmonise climate risk management with the organisation's strategic goals**

by creating clear and compatible policies and action plans with tailored objectives and targets.

- **Integrate climate risk management into all the organisation's processes**, seamlessly across departments and functions, such that climate risk assessments are considered in all decisions, e.g., budgeting, procurement, land-use planning and facility siting.
- **Allocate resources to risk reduction and resilience building** to protect the organisation's core tasks during crises.
- **Establish a multidisciplinary team, with well-defined roles and tasks in climate risk management**, equipped with resources, tools and appropriate authority, to analyse and propose measures for addressing climate risks across all departments and formations.
- **Foster a climate risk culture and enhance awareness**, via targeted educational and training programmes, and open communication on risks.
- **Ensure that climate risk management is equitable and inclusive** of vulnerable groups, but also gender-responsive.
- **Develop and strengthen staff expertise in climate risk management** by focusing on upskilling and reskilling, thereby adapting to evolving energy and environmental challenges.
- **Encourage a culture of continuous learning and adaptation**, enhancing skills that support energy-efficient missions and operations and sustainable practices.
- **Encourage safe and energy-efficient use of technology** that reduces environmental impacts.
- **Leverage procurement processes in the armed forces to facilitate climate action in the defence industry**, by applying green procurement and circular economy principles, and facilitating adherence to Environmental, Social and Governance (ESG) standards.

Outlook

The evolving landscape of climate hazards demands continuous research, foresight and innovation to refine our understanding of interconnected risks and their implications on the operational effectiveness of the armed forces. This includes establishing and maintaining a robust risk assessment framework to address the effects of climate change and support climate adaptation and resilience. On the other hand, a dedicated focus on climate change mitigation is vital to ensure an effective response and limit climate change impacts. However, reducing GHG emissions and promoting environmental sustainability requires a significant technological transition and a shift in societal and organisational attitudes and behaviour.

Future work should encompass a holistic approach to climate action in defence, addressing not only the strategic level, as done in this guide, but also the operational and tactical dimensions in which climate actions are implemented. This involves developing guidance for risk assessment to support climate adaptation at a more technical level, and guidance for monitoring, verifying and reporting GHG emissions to advance climate mitigation efforts. Such a comprehensive approach will lead to the creation of standardised guidelines and best practices, fostering the development of environmentally sound and climate-resilient solutions across all tiers of defence planning, processes, doctrines, missions and operations.

1. Introduction

Climate change affects well-being and safety, results in increased damage and loss of property, decreased reliability of infrastructure, disruption of critical services, increased threats to national and European security and a heavier burden on the armed forces due to successive calls to support crisis management operations in the wake of climate-related disasters.

Climate change manifests through various hazards, from severe climate and weather events like floods, storms, droughts or wildfires, to gradual shifts in temperature and precipitation patterns, ice melting and sea level rise. Armed forces that fail to adapt to climate change may face severe consequences and their operations may become compromised.

The defence workforce may be directly affected by climate hazards in their health, safety and overall well-being throughout the entire force generation cycle. These impacts can be felt during various stages, such as training, exercises, mobilisation, deployment and reintegration, in the form of various stressors such as environmental, metabolic or neuropsychiatric. An example is the increase of heat-related illnesses during military training. Additionally, climate impacts can also manifest as safety hazards, such as when triggered technological accidents expose individuals to hazardous substances stored or handled on a military site.

On the other hand, climate impacts can affect missions and operations by impeding access to fully functional infrastructure and assets at critical times. A collaborative study by the *European Commission's Joint Research Centre* (JRC) and the *European Defence Agency* (EDA) (Tavares da Costa et al., 2023) highlights the potential for severe damage to, destruction and inoperability of defence-related critical energy infrastructure due to climate-related events. This may have dire implications for the operational readiness, effectiveness and sustainability of the armed forces, but may also result in increased costs associated with the need for extensive inspection, maintenance, repair and potential replacement of assets or components.

Moreover, considering the reliance of military installations on essential services provided by civilian entities, such as electricity, fuel and water, as well as the nature of the critical infrastructure they operate, disruption is a cause for concern. Even a single component failure in any part of a system can rapidly escalate the disruption, propagating throughout and affecting other interconnected systems, and ultimately impacting military installations. This chain of impacts can include the triggering of technological accidents involving hazardous substances. For instance, damaged fuel storage tanks can result in uncontrolled releases, causing oil or chemical spills or even subsequent fires and explosions that further exacerbate consequences (Krausmann and Necci, 2021).

This guide addresses a recognised gap within the European defence sector, as well as echoes the expressed interest of EU Ministries of Defence (MoDs) in tailored guidance on climate risk management. It closely aligns with EU policy that recognises the interplay between climate change and security, and is expected to contribute to a more resilient European defence.

Overall, efforts aim to create a resilient European security agenda via EU-level coordination of strategies and action plans that link defence with sustainable energy and climate action, for example:

- In June 2019, the *Council of the European Union* highlighted the impact of climate change on EU security and defence, recognising its influence on global threats and military planning, and underlined the need for climate action to enhance sustainability and resilience ([1]).
- In June 2020, the *Council of the European Union* invited the *High Representative of the Union for Foreign Affairs and Security Policy*, the *European Commission* (EC) and the EDA to draw up a set of actions addressing defence and climate change – the *EU Climate Change and Defence Roadmap*, issued in November 2020 by

the *European External Action Service* (EEAS) ([2, 3]).

— In February 2022, the *European Commission* highlighted the need for innovation and strategic autonomy in European defence, with a focus on tackling climate change. This involves optimising energy consumption and resilience of critical technologies and of the armed forces ([4]).

— In March 2022, the *Strategic Compass for Security and Defence* identified climate change as a threat multiplier. It aims at strengthening resilience and achieving net-zero GHG emissions, urging full *EU Climate Change and Defence Roadmap* implementation and enhancing support to civilian crisis management operations ([5]). Notably, the *Strategic Compass for Security and Defence* also requires the drawing up of national defence strategies to prepare the armed forces for climate change by the end of 2023.

— In June 2023, a *Joint Communication on the climate-security nexus* set forth how the EU will address climate change and environmental degradation in peace, security and defence ([6]). As outlined in this *Joint Communication on the climate-security nexus*, one of the EU actions focuses on the need to conduct further research. As a result of this action, this guide was drawn up to help manage climate risk systematically and comprehensively in EU defence and minimise potential damage, loss and disruption due to climate and weather hazards.

— In January 2023, the *Critical Entities Resilience Directive* (CER Directive) ([7]) entered into force to strengthen the resilience of critical entities, a key concern in managing climate risk. It acknowledges the interdependency of critical infrastructure, which is of great relevance for EU defence, and complements the *EU Climate Adaptation Strategy* ([8]) that pursues a climate-resilient society by 2050.

In this context, this guide on climate risk management helps EU defence strengthen its resilience against climate impacts and gain a strategic advantage by preventing or reducing consequences, and responding and recovering swiftly from crises, thereby ensuring both continuity and sustainability. Integrating climate risk management in decision-making provides MoDs with a comprehensive view of their exposure to climate hazards and the vulnerabilities of elements of their organisation, missions and operations, enabling the prioritisation of risk reduction and resilience measures. By adopting climate risk management, Chiefs of Defence Staff empower their organisations to navigate climate change impacts. According to EDA's capability development analysis beyond 2040, climate change is poised to fundamentally reshape the future security and operational environment, thereby underscoring the urgency for EU armed forces to adapt and prepare (EDA, 2023).

Although climate risk management pertains to the climate action strand known as climate adaptation (i.e., preparing for and adjusting to the effects of climate change), it is also important to implement complementary measures pertaining to the other strand known as climate mitigation (i.e., efforts to reduce GHG emissions). Integrating both climate adaptation and mitigation into EU defence strategies and planning offers significant advantages. It enhances EU defence energy resilience and autonomy by reducing the reliance on fossil fuels, increasing energy efficiency and transitioning to renewable energy sources, with improvements in operational flexibility and potentially cost reductions. Moreover, it positions the EU's armed forces to effectively manage climate-related threats. Aligning EU defence goals with global climate action ensures a more effective response to climate change.

This guide starts by setting the context in this introduction. Sections 2 and 3 explore the fundamentals of climate risk, elaborating on climate impacts and the two strands of climate action: climate change adaptation and climate change mitigation. Section 4 underscores the imperative for defence leaders to engage with climate action, highlighting its relevance in decision-making. In Section 5, the key role of

leaders in climate risk management is examined, emphasising the responsibility of Chiefs of Defence Staff in shaping their organisation's resilience and sustainability. The climate risk management cycle, detailed in Section 6, outlines a framework to manage climate risk in EU defence. Section 7 focuses on the significance of effectively communicating climate risk, and Section 8 provides a set of actions to enable climate risk management. Finally, the Annex included in this study provides a checklist for Chiefs of Defence Staff to self-assess the status of climate risk management in their organisation, and to help set in motion climate change adaptation. More concretely, the checklist addresses each of the following topics:

- Risk awareness;
- Leadership and risk culture;
- Risk information;
- Risk management expertise;
- Prevention and risk treatment;
- Emergency response and recovery.

THIS CLIMATE RISK MANAGEMENT GUIDE FOR CHIEFS OF DEFENCE STAFF IS A KEY TOOL, SHOWING THE IMPORTANT LINK BETWEEN CLIMATE CHANGE AND DEFENCE. IT LAYS THE GROUNDWORK FOR A CLIMATE RISK MANAGEMENT FRAMEWORK, ESSENTIAL FOR EFFECTIVELY NAVIGATING AND MITIGATING CLIMATE RISKS WITHIN THE DEFENCE SECTOR

2. The Fundamentals of Climate Risk

Climate change refers to shifts in the state of the climate system that give rise to substantial and enduring shifts of weather patterns, as well as accelerated melting of land and sea ice, and sea level rise (Figure 1 clarifies the difference between weather and climate). Climate change is driven by a global average temperature rise (currently at about 1.2 °C global warming level) ([9]) associated to a high concentration of GHGs in the atmosphere (currently at about 416 parts per million) ([10]). The concentration of GHGs in the atmosphere far exceeds its natural range in the Holocene, and has origin in human activities such as the combustion of fossil fuels and the modification of ecosystems (land use change). While natural climate variability such as El Niño exists, the influence of human activity on climate change is unequivocally distinguishable and exceeds historical variations (IPCC, 2021).

The ongoing trend in GHG emissions will inevitably continue to drive up the global average temperature, which will lead to further changes of the Earth's climate. Irreversible alterations to the climate system, referred to as tipping points (e.g., the collapse of the Atlantic Meridional Overturning Circulation – AMOC) ([11]), may occur if we cross a certain global warming level, and the safe limits within which human life can thrive may also be exceeded. Therefore, while continuing to reduce GHG emissions, it is also essential to effectively manage **climate risk**, which refers to the **likelihood of elements of an organisation, and its missions and operations, experiencing a climate-related effect** (e.g., a heatwave affecting the health of staff or a flood disrupting a military installation). This likelihood is changing, either gradually or abruptly, and depends on the susceptibility to damage (vulnerability) of a community, sector, site, system, process, project or operation, the ability to cope and adapt, and the geographical location.

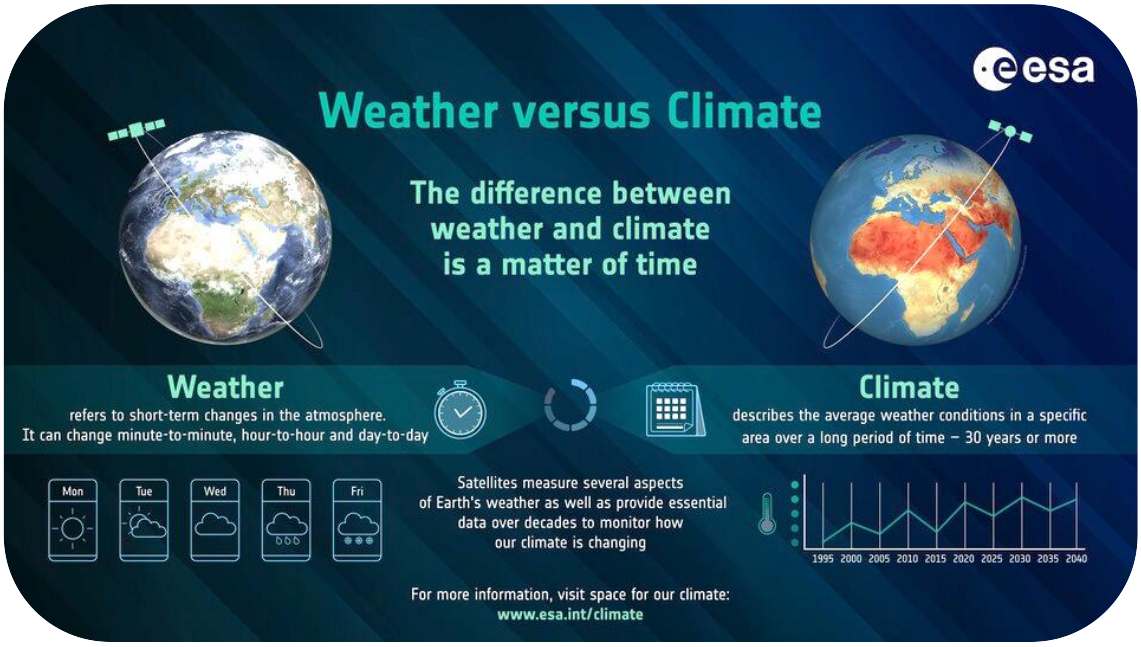


Figure 1. The difference between weather and climate. Although natural climate variability is not represented, its timescale (months to decades) includes phenomena such as the El Niño–Southern Oscillation (ENSO), the North Atlantic Oscillation (NAO) or the Atlantic Multi-decadal Oscillation (AMO), and lies between the timescales of weather (minutes to months) and climate change (decades to centuries). Source: European Space Agency (ESA).

Box 1. Why does the spotlight shine on carbon emissions while other greenhouse gases remain in the shadows?

Carbon dioxide (CO_2) is considered the reference GHG. Although there are multiple GHGs (e.g., methane – CH_4, nitrogen oxide – N_2O etc.), their emissions to the atmosphere are expressed in equivalent mass of CO_2 (e.g., kg CO_{2eq}). This allows emissions to the atmosphere of different GHGs to be added together under a common unit of measurement, and to estimate their overall contribution to global warming. Thus, the informal term "carbon emissions" should more accurately be understood as emission of GHGs to the atmosphere expressed in equivalent mass of CO_2. This is why also the informal term "decarbonisation" should be more accurately understood as reducing overall GHG emissions to the atmosphere.

In this context, global warming potential (GWP) is a measure of the relative contribution of a GHG to global warming. It indicates the amount of heat a GHG can trap in the atmosphere over 100 years, relative to that of CO_2, which has a GWP of one and may persist in the atmosphere for up to 100 years (i.e., its lifetime).

2.1. Climate change impacts

Climate change, driven by both natural factors and GHG emissions from human activities, produce changes in climate variables such as temperature, precipitation (i.e., rainfall, snow, ice or hail), wind and humidity. Changes occur in the average values of variables (climate averages), but also in their extremes (i.e., the lowest or highest values of a variable – climate extremes).

Overall, changes in climate averages have wide-ranging effects on various operational conditions in different sectors, including in defence. For example, increased temperatures lead to malfunctioning and increased wear and tear of certain equipment and infrastructure, increase of heat-related illnesses in staff, or to higher energy demand and costs associated to cooling and ventilation.

Changes in climate extremes are represented by changes in event frequency, intensity, timing, duration and location. They are often characterised as having a lower likelihood of exceeding a certain higher intensity (high-impact low-probability events), or a higher likelihood of exceeding a certain lower intensity (low-impact high-probability events). Both cases are important, as frequent lower intensity events can lead to cumulative impacts (e.g., frequent repairs) or the simple obstruction of daily tasks, while higher intensity events that are uncommon may catch communities and the armed forces unprepared and lead to catastrophic consequences.

More broadly, Figure 2 illustrates the interplay between natural hazards that may be influenced by a changing climate (climate hazards), the understanding of which is vital for effective climate risk management.

A climate impact, whether it is social, economic or environmental, will only materialise when three conditions are satisfied:

1. **a climate hazard occurs**;
2. **a natural or human-made system is situated in an area exposed to that hazard, or depends on a system disrupted by that hazard**;
3. **a natural or human-made system is vulnerable to that hazard or disruption** (in contrast, a waterproof system may be unaffected by a flood, or a microgrid with its own energy generation may disconnect from the main power grid and resist a cascading power outage etc.).

Furthermore, a system might not require absolute protection, or this may not be feasible to attain (e.g., due to cost), and a certain (lower) level of functionality could still be deemed acceptable for a specific event duration. In such instances, an effective response to the impact and a swift recovery of the system become important measures of resilience.

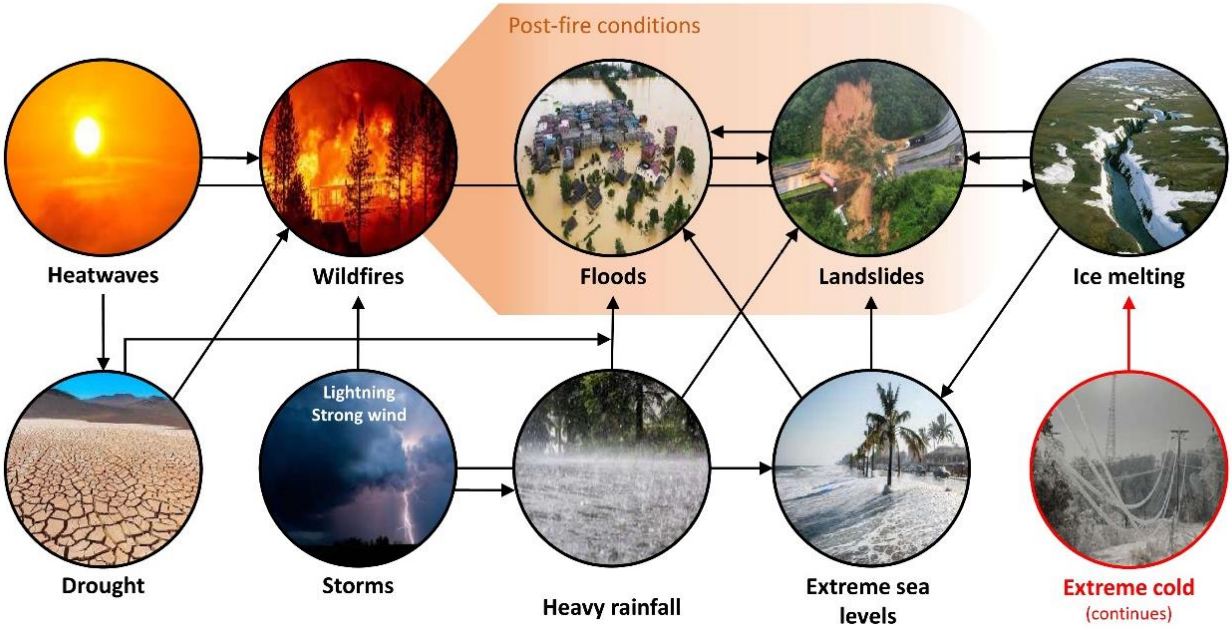


Figure 2. The relation between climate hazards gives rise to an intricate chain of impacts, where the occurrence of one hazard can trigger another. Climate hazards may also happen simultaneously and self-reinforce, resulting in diverse consequences to natural and human-made systems.

Box 2. Making informed decisions with weather forecasts and climate projections.

Weather forecasting is the estimate of short-term weather conditions for a limited time frame, usually up to two weeks. Weather forecasting is crucial for issuing early warnings to protect life and property.

Climate projections, on the other hand, involve estimating long-term trends and changes in the Earth's climate over decades to centuries. Climate projections explore future climates under the assumption of varying conditions, such as different trends in GHG emissions and associated socio-economic pathways, and can be used for infrastructure investment decisions, strategic planning and policy formulation.

Climate scenarios are plausible representations of future climates, generally consistent with climate projections, that are used to explore the potential consequences of climate change.

It is important to mention **downscaling** as a method, among others, that connects climate projections to regional- or local-scales, serving various applications such as climate risk assessments. Downscaling is used for enhancing the spatial resolution of climate information, providing more detailed and localised data for risk-based decision-making.

Climate projections and climate scenarios can be employed for climate risk management, to develop climate adaptation strategies, training, raising awareness and more.

Box 3. Explosions at an ammunition depot in Greece due to rampant wildfire.

On 27 July 2023, a destructive wildfire flared up in central Greece, raging on three fronts ([12]), fuelled by climate change that enabled the favourable conditions for its intensification (Georgoulias et al., 2022; Zachariah et al., 2023) ([13]). Despite firefighting efforts, the wildfire rapidly propagated with the help of strong winds ([14, 15]), leaving behind a trail of devastation, leading to the closure of a major highway, disrupting train services and putting industrial areas at risk ([12, 16, 17]).

In Karambas, located about 6 km north of a military airbase in Nea Anchialos, the flames engulfed an ammunition depot owned by the Hellenic Air Force, generating a substantial thermal load ([18]). Insufficient management of the surrounding vegetation and a narrow firebreak zone facilitated the fire's expansion ([15, 19]). The storage facility comprised both above-ground sheltered dug-out spaces and NATO-certified underground storage units, densely packed with 250, 500 and 1 000 kg missiles and bombs intended for fighter jets ([14, 15, 20, 21]). The thermal load from the fire resulted in varying intensity explosions, which the fire safety measures could not prevent ([14, 22]). Notably, witnesses observed a fireball during these events ([14, 23]). The explosions shook the ground, which was detected by an array of seismographs ([15, 24]). Satellite images from the European Space Agency's Sentinel missions suggest that the underground storage units remained unaffected ([25]). Additionally, NATO-style blast protection embankments appear to have mitigated a portion of the shockwave from reaching the nearby town of Nea Anchialos ([25]).

Swift and vigilant measures were taken by authorities, who closely monitored the unfolding situation and promptly issued alerts ([18, 22]). Church bells chimed as a warning to residents and a traffic ban was swiftly imposed within a 3 km radius from the site ([14, 22]). Evacuation orders were issued to safeguard the well-being of around 2 000 individuals; 133 people managed to escape via sea routes ([14, 22]). Despite the explosions causing shattered windows in nearby areas, fragments scattering over long distances and the blasts' sound heard up to 20 km away, no major injuries were reported ([16, 22, 26]). Of crucial importance to national security, the Nea Anchialos airbase houses 70 out of Greece's 154 F-16 fighter jets, including specialised squadrons dedicated to interception, enemy air defence suppression, attack missions and advanced training ([20]). As a precaution, the F-16 aircrafts stationed at the Nea Anchialos airbase were relocated to Larissa airbase, also in Greece ([14, 18, 27]).

Once deemed safe, experts from the Greek Air Force and Greek Army firefighters intervened by applying coolant to the ammunition depot ([14]). Their efforts brought the fire under control, rendering the airbase secure from immediate peril ([14]). However, the potential presence of scattered projectiles and ammunition in the vicinity of the base warrants vigilance ([14]).

While an official investigation into the incident has indicated omissions and negligence ([19]), the profound repercussions of this incident, including the reputational damages, serve as a stark reminder of the pressing need to proactively confront the challenges posed by climate change in defence.

2.2. 360-degree view of climate impacts on defence: scope of application

Climate change can lead to a variety of impacts that can affect defence in a non-trivial manner. It is important to recognise this before moving forward with the implementation of a climate risk management framework. In Tavares da Costa et al. (2023), two comprehensive tables detailing the impacts of climate change can be found, one focusing on military installations and military capabilities and the other on defence-related critical energy infrastructure (electricity, oil and gas). Consulting these tables could be beneficial not only for increasing awareness about climate change effects, but also for conducting a preliminary hazard analysis for a specific sector, organisation, its elements, missions and operations, and for strengthening resilience.

Different levels of an organisation can be affected by climate hazards, and an impact experienced in a military installation can impair military capabilities, with potential consequences for operational effectiveness, readiness and sustainability of the armed forces. At the same time, the armed forces depend on civilian services provided via critical infrastructures and defence industry supply chains.

Owning to the characteristics of critical infrastructures, such as vast geographical extent, sometimes narrow operating limits, and aging components, exposure and vulnerability of these systems to climate hazards may be increasing. Furthermore, their connectivity and interdependence imply that

disruptions can propagate within and across sectors (as defined in the CER Directive: energy, transport, banking, financial markets, health, drinking water, wastewater, digital, public administration, space and food).

Moreover, since the military store, handle and transport dangerous substances (e.g., fuels, ammunition etc.), secondary technological accidents triggered by climate hazards, which involve the release of dangerous substances, can create additional consequences and cascading effects on- and off-site, or amplify existing ones.

In Figure 3, a **360-degree view of climate risk management in defence** that can be generalised to any climate-hazard, is provided and is composed of three distinct layers:

- A community layer where critical infrastructure and supply chains are operated, providing the civilian services needed by the armed forces;
- A military installation layer, comprising staff, infrastructure and assets, which is inserted in a community and from where impacts may cascade to military capabilities;
- A missions and operations layer, which may also depend on civilian services (e.g., refuelling).

It is important to note that all the layers may be affected by a climate hazard and are subject to human factors, i.e., the human actions and decisions that can influence safety, environment, health and security outcomes. **Figure 3 maps the main pathways for climate impacts in defence, direct or indirect, providing a general scope of application for the climate risk management framework**. Figure 3 should guide the decision of Chiefs of Defence Staff on the most appropriate level to implement climate risk management, according to the specificities of each organisation and its resources.

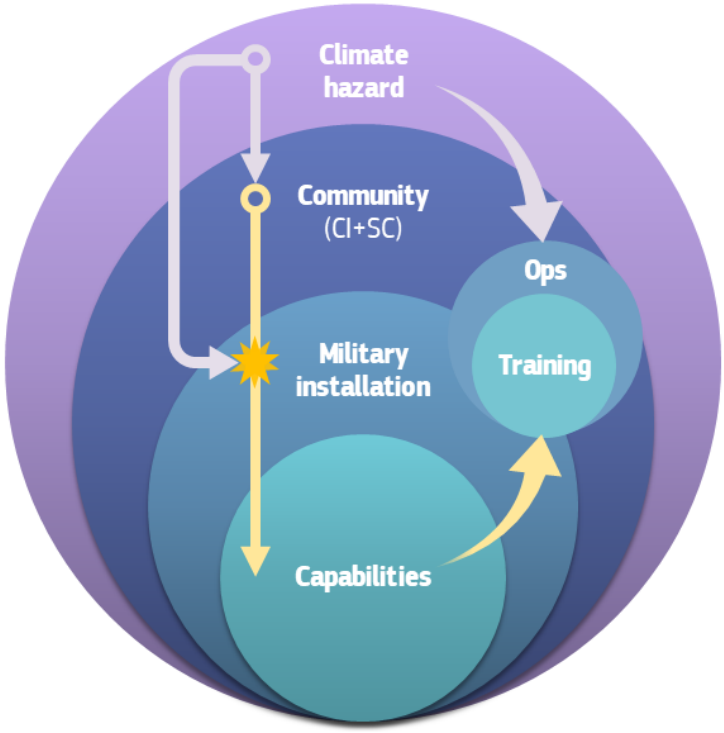


Figure 3. A 360-degree view of climate impacts on defence and scope of application for the climate risk management framework. Grey arrows represent direct impacts, while yellow arrows represent indirect impacts. A technological accident, represented by the orange star, can be triggered by a climate hazard and cascade to assets or systems, impacting a military installation and/or disrupting military capabilities. CI stands for critical infrastructure, SC for supply chain and Ops for missions and operations.

A DEEP DIVE INTO THE MULTI-FACETED NATURE OF CLIMATE CHANGE OFFERS A 360-DEGREE PERSPECTIVE ON THE DIRECT AND INDIRECT IMPACTS THAT MAY AFFECT THE DEFENCE SECTOR, UNDERSCORING THE IMPORTANCE OF INTEGRATING CLIMATE RISK MANAGEMENT INTO DEFENCE PLANNING

3. Climate Action for a Resilient Future

Climate change presents a challenge that demands a comprehensive response encompassing both climate change mitigation and adaptation strategies. This integrated approach to climate action is of paramount importance, recognising that the distinct strands complement one another and bring about co-benefits. While climate change mitigation strives to reduce GHG emissions and change the course of global warming, climate adaptation strengthens our resilience to the changes already set in motion.

3.1. Climate change adaptation

Climate change adaptation represents the indispensable adjustments and transformations in ecological, social or economic systems that respond to present and expected changes in the climate. Climate change adaptation is at the core of this guide, to which climate risk management contributes significantly.

Climate change adaptation entails a comprehensive examination of dynamic alterations of climate averages across varying timescales, spanning from shorter periods of months to more extensive spans of decades. In parallel, a comprehensive assessment of the shifting characteristics of climate extremes must be undertaken. This understanding is then combined with information on the exposure, default operating conditions and changing vulnerability of staff, infrastructure, assets and capabilities. For the case of infrastructure and assets it is important to note that these are contingent upon factors such as component aging, utilisation patterns and maintenance, repair and overhaul regimes.

The primary objective of this process is the identification of priority interventions, thereby justifying the prudent allocation of resources and efforts. This strategic approach has the explicit intent of preventing or, at the very least, controlling the extent of harm, damage and loss linked to current, but also medium and long-term climate impacts. Climate risk analyses serve as a tool to strengthen resilience, and can be further used for contracting insurance, thereby safeguarding MoDs against potential financial losses.

3.2. Climate change mitigation

Climate change mitigation represents the fundamental principle of reducing the release of GHGs to the atmosphere. These GHG emissions have their origin in human activities and contribute to global warming.

The main objective lies in fostering a transition towards a net-zero emissions economy, one that is compatible with the natural balance of ecosystems, which does not pose an existential threat to communities and future generations, and does not make the planet a more dangerous place to live.

A comprehensive approach to **climate change mitigation involves five types of actions** (as illustrated in Figure 4):

1. **Rethink**: Replacing existing products, processes and procedures with alternatives that result in less GHG emissions.
2. **Reduce**: Optimising existing processes and procedures for higher energy efficiency and less GHG emissions.
3. **Replace**: Integrating new technology, such as renewable energy systems in existing processes, which result in less GHG emissions.
4. **Recompense**: Compensating GHG emissions with investments, often in the form of carbon credits, which remove an equal amount of GHGs from the atmosphere (carbon offset).
5. **Remove**: Controlling GHG emissions by using emission control technologies that separate or transform air pollutants and GHGs from process streams (e.g., scrubbers) or directly from the atmosphere (e.g., direct air carbon capture and storage – CCS).

Strategic and proactive climate action is key to effectively address the challenges posed by global warming and climate change. It entails a commitment to develop climate strategies that include clear and quantifiable GHG emissions reduction targets, to rigorously and diligently monitor, verify and report GHG emissions, and to reduce these at every stage of a process or a product.

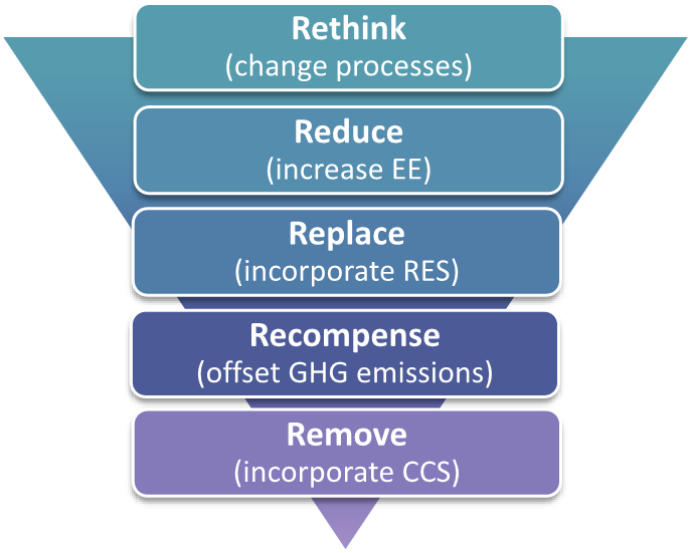


Figure 4. The five actions that can be taken for a comprehensive approach to climate mitigation. GHG stands for greenhouse gases, EE for energy efficiency, RES for renewable energy systems, while CCS stands for carbon capture and storage.

Box 4. Decoding the green jargon: net-zero carbon, net-zero emissions or net-zero energy?

When speaking about climate change mitigation, net-zero carbon (or carbon neutrality), net-zero emissions (or climate neutrality) and net-zero energy are terms often used interchangeably. However, each holds a distinct meaning and may deliver different results, as explained in the following table:

	Aim	Examples of measures
Carbon neutrality (net-zero carbon)	Balances emitted CO_2 with its removal from the atmosphere	Reforestation, afforestation and CCS
Climate neutrality (net-zero emissions)	Extends beyond CO_2 to balance all emitted GHGs with their removal from the atmosphere	Any control measures for CH_4, N_2O and halogenated gases (e.g., sulphur hexafluoride – SF_6)
Net-zero energy	Develop systems that generate as much energy as they consume*	Synergy between energy efficiency, renewable energy systems, alternative fuels and energy storage

* Does not imply a reduction of GHG emissions unless energy is generated by zero-emission sources. It may actually imply an increase of GHG emissions.

FOR A RESILIENT FUTURE, CLIMATE ACTION IN DEFENCE IS NOT JUST A NECESSITY BUT A STRATEGIC ADVANTAGE, OFFERING OPERATIONAL, ECONOMIC AND SOCIETAL BENEFITS, INCLUDING COST SAVINGS AND ENHANCED RESILIENCE. IT SETS A GLOBAL LEADERSHIP EXAMPLE IN THE FIGHT AGAINST CLIMATE CHANGE

4. Why Chiefs of Defence Staff Should Take Action on Climate Change

Climate change introduces new variables, including a temporal dimension, and uncertainties into strategic planning and risk analysis that need to be considered. It presents a significant challenge that intersects national and European security with defence concerns. EDA's analysis for enhancing EU military capabilities beyond 2040 (EDA, 2023) identifies **climate change as one of six factors that will shape the strategic context** (Figure 5), particularly the future security and operational environment. Hence, the consequences of climate change could be intentionally exploited, leading to significant security challenges.

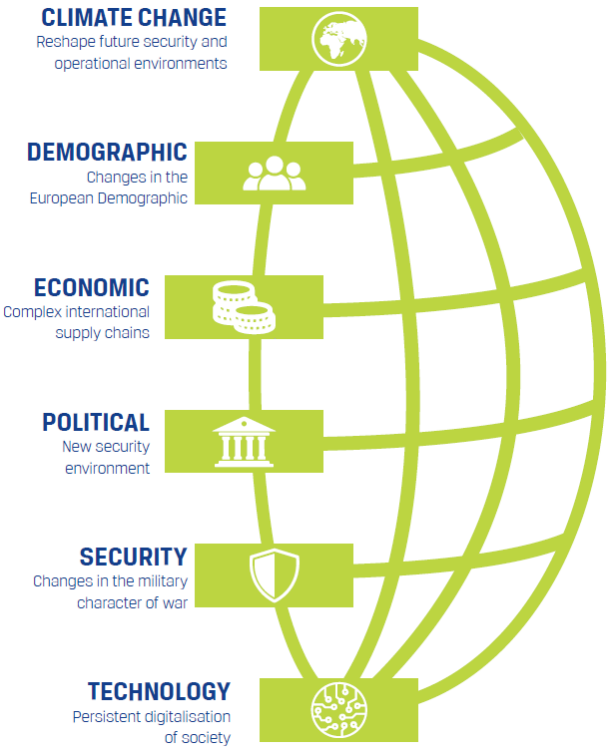


Figure 5. Main factors that will shape the strategic context, beyond 2040, for the development of defence and security capabilities. Source: European Defence Agency

This evolving landscape underscores the urgency for the armed forces to adapt to climate change. Climate risk management enables the armed forces to better anticipate and prevent, prepare for, respond to and recover from the impacts of climate change. In this context, **the urgency for Chiefs of Defence Staff to take climate action should be driven by several compelling reasons**:

1. **Geopolitical Instability**: The potential of climate change to escalate tensions and foster instability should raise concerns among Chiefs of Defence Staff. The interplay between environmental degradation, resource scarcity and severe weather can trigger disputes and amplify conflicts, which will need anticipation and effective management. Moreover, the vulnerabilities of communities exposed to these conditions offer opportunities for certain actors to exploit them. All these factors may, in turn, lead to the displacement of populations, heightening border tensions. Finally, competition for previously inaccessible areas and resources such as those in the Arctic, may also lead to new disputes.
2. **Vulnerability of staff, infrastructure, assets and capabilities**: The vulnerability of staff, military infrastructure, assets and capabilities to climate change should be of serious concern. On the other hand, the vulnerability of critical (civilian) infrastructures to climate change may result in the disruption of vital services and supply chains. Such circumstances may significantly undermine operational readiness and overall effectiveness of the armed forces and a notable financial burden may be imposed on defence budgets via loss and damage. Additionally, the climate-induced rise in maintenance, repair and overhaul requirements may further divert resources. Compounding this issue, there may be an increasing number of days where facilities become inaccessible,

equipment becomes inoperable due to conditions surpassing design thresholds, or instances of sick leave surge due to severe weather conditions.

3. **Energy security**: A strong reliance on fossil fuel imports limits autonomy, energy security and resilience to energy crises. It perpetuates the potential for a high number of casualties incurred while protecting fuel convoys during conflicts. Moreover, as economies shift to net-zero emissions, there is the prospect of diminished availability and increased costs of fossil fuel technologies, components, spare parts, infrastructure and expertise, thereby rendering these systems harder to maintain, repair or overhaul.
4. **Humanitarian assistance and disaster response**: Climate-related disasters may significantly strain military capabilities, increasing the demand for defence staff to participate in disaster assistance. This can potentially diminish readiness for core defence tasks, assuming military involvement in disaster assistance will increase in importance.
5. **Reputation and public support**: Achieving climate mitigation targets requires addressing military GHG emissions. Significant pressure from various stakeholders may increase, including regulators and staff, but also the general public. Failure to address climate change mitigation in defence could damage the reputation and public support for the armed forces, which may in turn impact morale.

While the initial efforts made by MoDs in formulating climate strategies (e.g., Hellenic Republic Ministry of National Defence, 2023; Ministère des Armées, 2022; Ministerio de Defensa, 2023) are noteworthy and substantial, there are persistent concerns related to ensuring consistent commitments. These concerns encompass quantifiable targets, harmonised monitoring, reporting and verification of GHG emissions and the adopted methodology to do so, as well as the detailed action plans for reducing GHG emissions. This hinders the pace and breadth of climate action in the defence sector and could potentially lead to unanticipated challenges, particularly in terms of interoperability issues arising from the adoption of different technologies and fuels among NATO allies.

A key factor that is delaying climate action within the defence sector is the perception of the need for a trade-off between operational effectiveness, costs and the reduction of GHG emissions. Nevertheless, **there is no reason why the reduction of GHG emissions cannot be seen as an opportunity to modernise and obtain a strategic advantage in defence**. For instance, MoDs can request GHG emission reduction targets from their contractors. This could be achieved by mandating the disclosure of GHG emissions throughout a product's lifecycle, potentially integrating it into green procurement criteria. Suppliers that showcase less climate impact and deliver low-carbon goods or services will be more apt to retain and secure market share in the future.

Other driving factors that delay climate action include:

1. **Core defence priorities vs. climate action**: Core defence tasks and budget limitations are given higher priority than climate action in defence planning. Short-term priorities often overshadow climate action due to its perception as a medium- to long-term concern. This lack of perceived immediate threat is linked to differing levels of climate literacy and awareness among military staff in general, Chiefs of Defence Staff and MoDs.
2. **Preparedness paradox**: The preparedness paradox affects motivation to proactively engage in risk reduction and resilience building because of the perception of low risk of harm or damage, either due to positive historical experience or effectiveness of the risk treatment, but also leadership complacency.
3. **Investment lifespan vs. urgency**: The long lifespans of investments, military infrastructure and assets clash with the urgency of climate action. Reluctance to adopt new, cleaner and resilient solutions arises due to risk aversion, unfamiliarity and insufficient testing and validation of new technologies

and processes. Moreover, pursuing innovation might need critical raw minerals that can potentially result in new supply chain dependencies.

4. **Organisational and cultural barriers to climate adaptation**: The defence sector's inherent organisational culture, along with well-established doctrines and complex bureaucratic procedures, significantly hinders the timely implementation of climate action. These structures and practices often lead to delays in adopting the necessary measures to address climate change, highlighting the urgent need for a cultural, behavioural and procedural transformation.
5. **Skills gap in climate action**: Effective climate action needs adequate staffing and training. These requirements might not exist in the current skill sets of the defence workforce. This gap highlights a lack of a defence-oriented climate culture, essential for understanding and addressing the unique challenges of climate change in military contexts.

Efforts aimed at ensuring climate action in defence do not need to compromise operational effectiveness. It is imperative to view this challenge as possible to overcome and as an opportunity for the sector. The implications of climate change for security, along with the valuable lessons learned from catastrophic events, serve as a stark reminder of the urgent need for action. **The military is key in safeguarding stability and defending countries against various threats**. In doing so, **it is essential that they are aware of ecological limits and the broader planetary boundaries, particularly in pursuit of the imperative of energy resilience and security,** when making such decisions ([28]).

Moreover, **the far-reaching economic and societal dividends of climate action may be significant.** While initial investments may be needed, the gains in energy efficiency, cost savings including from reduced fuel and maintenance expenses, lifetime of assets and their availability, autonomy and resilience, can compensate initial spending. **Substantial cost savings may be achieved by pre-empting loss and damage during disasters, optimising response, recovery and post-disaster reconstruction.** Such a proactive approach can save lives and reduce consequences, including the forced disruptions of critical infrastructure.

Finally, there are legitimate expectations from countries to their defence leaders to contribute to national and global efforts to fight climate change, providing an opportunity to demonstrate global leadership and commitment, and to foster new or strengthen existing international cooperation on shared security challenges.

Box 5. Considerations for climate risk management.

- The management of climate risk requires a multi-disciplinary approach – experts such as climate scientists, meteorologists, hydrologists, oceanographers working alongside civil, mechanical and chemical engineers, as well as experts on process safety;
- Even though tools such as weather forecasts, early warnings and alert systems, and climate projections and scenarios may exist, there is a degree of uncertainty regarding climate impacts. Moreover, a worst-case scenario may be difficult to define;
- Climate hazards can impact critical infrastructure, such as electric power grids, fuel and water pipelines, communication systems and transport routes, all used by the military;
- As a result of climate impacts, major technological accidents due to the storing, handling and transporting of dangerous substances (e.g., ammunition, explosives, fuels etc.) can occur simultaneously at several locations and can be exacerbated by disrupted critical infrastructure (e.g., power, water, communications etc.);
- One climate impact can trigger another impact, leading to cascading effects, which can aggravate overall consequences. For example, the failure of the power grid because of storm damage, can disrupt gas stations, which need electricity, and thus the supply of fuels;
- Both low-impact high-probability and high-impact low-probability climate hazards should be taken into account. The first type may hamper daily tasks or lead to cumulative and long-term effects, while the second type may produce catastrophic consequences.

CHIEFS OF DEFENCE STAFF MUST INTEGRATE CLIMATE CHANGE CONSIDERATIONS INTO RISK MANAGEMENT, FOSTERING DECISION-MAKING BASED ON CLIMATE PROJECTIONS AND SCENARIOS. THIS APPROACH ALIGNS CLIMATE RISK MANAGEMENT WITH STRATEGIC GOALS, ENHANCING OPERATIONAL EFFECTIVENESS

5. The Role of Leadership in Climate Risk Management

Chiefs of Defence Staff play a key role in shaping an organisation's risk culture, using their authority to expand risk management beyond traditional security concerns to encompass climate change. This must be accompanied by the responsibility to create an atmosphere for open risk communication that encourages discussing less favourable risk analysis outcomes (e.g., identifying the need to replace military infrastructure, when there are budget constraints), recommendations, conclusions from incident investigations including near misses, and the associated lessons learned. This openness is key for attaining effective climate risk management.

Chiefs of Defence Staff should transcend decision-making within a stable context, i.e., making choices under uncertainty, informed by projected short-, medium- and long-term changes to the large variety of factors affecting the organisation. This can be challenging, but consulting various experts (including internal and independent experts if needed), scrutinising assumptions and implications, and making choices that are effective across a wide range of scenarios can be beneficial. While every decision carries a degree of uncertainty, skilful leadership anticipates and proactively adapts to changes. Moreover, organisations that often emerge unscathed from crises exhibit a robust risk culture underscored by good risk management practices and coherent climate strategies.

Furthermore, there is a link between risk management and strategic planning, which arises from the need to prevent or reduce damage and loss of property from climate impacts, ensure uninterrupted operations or an acceptable level of functionality, which leads to operational advantages.

Hence, **Chiefs of Defence Staff should demonstrate their commitment through proactive actions**:

1. **Risk awareness**: Foster the understanding of climate change and the complete range of climate hazards that may threaten the organisation, its staff, infrastructure, assets and capabilities, missions and operations. This includes awareness of extreme weather events such as intense heatwaves impacting troop deployment areas, rising sea levels affecting naval bases or increased frequency of severe storms disrupting supply chains. Also, a profound understanding of the changing operating conditions as a result of climate change, like terrain and weather patterns affecting military tactics, and their potential impacts on safety at specific locations, is required. Overall, risk awareness should help the understanding of potential cascading effects that may emerge from the interaction of various hazards and systems, how climate change might lead to heightened conflict risk over resources, and how different vulnerable groups and genders are affected by climate change.
2. **Education, training and exercises**: Integrate climate change into military curricula to prepare staff for its strategic and operational impacts. Ensure regular training and simulations in this context, including tabletop exercises (TTX) to test and assess response strategies to climate-induced crises. Such exercises enhance response capabilities, situational awareness and foster collaboration between defence and civilian stakeholders, which is vital in a rapidly evolving operational environment. Consider developing targeted educational and training programmes (e.g., gender-specific, veterans).
3. **Expertise**: Ensure that the necessary skills for climate risk management exist in the organisation or are developed. Where necessary, make use of external expertise. Also, recognise that climate risk management requires a dedicated team with clear roles, responsibilities, appropriate resources and authority. It also

requires a multidisciplinary approach and collaboration among different stakeholders, including those operating critical infrastructure, to analyse and propose measures to address evolving risks, effectively reducing climate risk and strengthening resilience.

4. **Climate risk communication**: Implement throughout the organisation effective (open) risk communication to raise awareness about climate change and the need for climate action, but most importantly about climate-related risks, including the measures in place to control risk and actions to be taken if that risk materialises (emergency plans). Cultivate a risk culture that is more proactive than reactive, prioritising both prevention and preparedness, but also with a view to shaping the way staff interacts with technological systems and the environment in order to promote safety and energy efficiency.

5. **Climate risk management**: Promote the development, review and – where necessary – enhancement of risk management policies, implement regular risk reporting, a risk register, the use of early warning systems and the preparation of emergency plans. Ensure that these are adaptable to evolving risks due to changing climate hazards, exposure or vulnerability of elements of an organisation, missions and operations.

6. **Climate-informed decision-making**: Integrate climate change information into decision-making processes at all levels of the organisation, and seamlessly across all departments and functions, including insights from comprehensive climate risk assessments. Key findings from climate risk assessments should contribute to decisions, for example in procurement, land-use planning and siting of facilities. Align climate risk management with the strategic direction of the organisation, establishing clear and compatible policies, objectives and targets. Furthermore, consider using procurement to facilitate climate action in the defence industry.

7. **Invest in resilience**: Safeguard core defence tasks during crises by allocating resources for risk management and resilience building, accounting for both worst-case scenarios and low-impact high-probability events, whose frequent occurrence may lead to non-negligible consequences. Allocate resources for risk reduction and resilience building to protect the organisation's core tasks during crises.

8. **Critical infrastructure protection**: Recognise that climate change can disrupt civilian or military critical infrastructure the armed forces may depend upon for their functioning and capabilities, like power grids, pipelines and communication networks. Foster the development of additional capabilities to address the protection of critical infrastructure in a climate-change context, and ensure collaboration with relevant stakeholders, including civilian, to strengthen infrastructure resilience.

The acknowledgment by Chiefs of Defence Staff of the need for climate action stands as a key element. Their involvement counters the misconception that climate action always opposes operational effectiveness, for which there is no clear evidence given the existence of various possible options for risk reduction and resilience building, but also to reduce GHG emissions, including measures aimed at the defence industry. Moreover, the leadership's influence should span across departments and functions such as procurement, infrastructure, information, training, missions and operations. The current context requires a good deal of innovation, including technological, but also organisational and behavioural change. For example, corporate leadership is already taking steps, with executives embracing climate investments, and this is mostly because they are experiencing the negative effects of climate change ([29]).

Ultimately, it should also be clear that establishing sound climate risk management helps to prevent incidents, reduce adverse consequences and limit financial losses, all impacting an organisation, from defence

workforce safety to reputational damages (see Box 3 for example) and budgetary pressure. This translates into well-managed assets and streamlined processes, especially when accompanied by increased adaptability, which, in turn, reduces capability downtimes, enhancing availability, operational readiness, overall effectiveness and sustainability.

STRONG LEADERSHIP, FIRM COMMITMENT AND INNOVATION ARE ESSENTIAL FOR EFFECTIVE CLIMATE RISK MANAGEMENT IN DEFENCE. LEADERSHIP IS CRUCIAL FOR EMBEDDING CLIMATE STRATEGIES WITHIN DEFENCE, FOSTERING CLIMATE AWARENESS, RESILIENCE AND PROACTIVE DECISION-MAKING

6. The Climate Risk Management Framework

Risk management helps organisations to deal with internal and external factors that introduce uncertainty in the achievement of their objectives (Necci and Krausmann, 2022). Its success depends on its integration into the governance of the organisation, requiring leadership support and the commitment of all staff. Climate risk management takes traditional risk management to a new level by incorporating short-, medium- and long-term climate projections, and climate scenarios, in prevention and emergency preparedness. It allows for a more comprehensive understanding of the potential risks associated with climate change, aiding the development of strategies and actions to treat these risks, and a better emergency response and recovery.

In Figure 3, the general scope of application for this framework in defence has been presented and it should guide the decision of Chiefs of Defence Staff on the most appropriate level to implement climate risk management in their organisation.

The main goal of climate risk management in defence is to ensure military operational readiness and effectiveness at the onset of a climate-related crisis and over long timeframes by analysing climate risk, evaluating it against risk acceptability criteria and treating it (i.e., reducing risk), where deemed necessary, including preparing for emergency response and recovery (ISO 2018, 2021). To include all these dimensions, **the climate risk management framework** presented in Figure 6 entails two complete cycles.

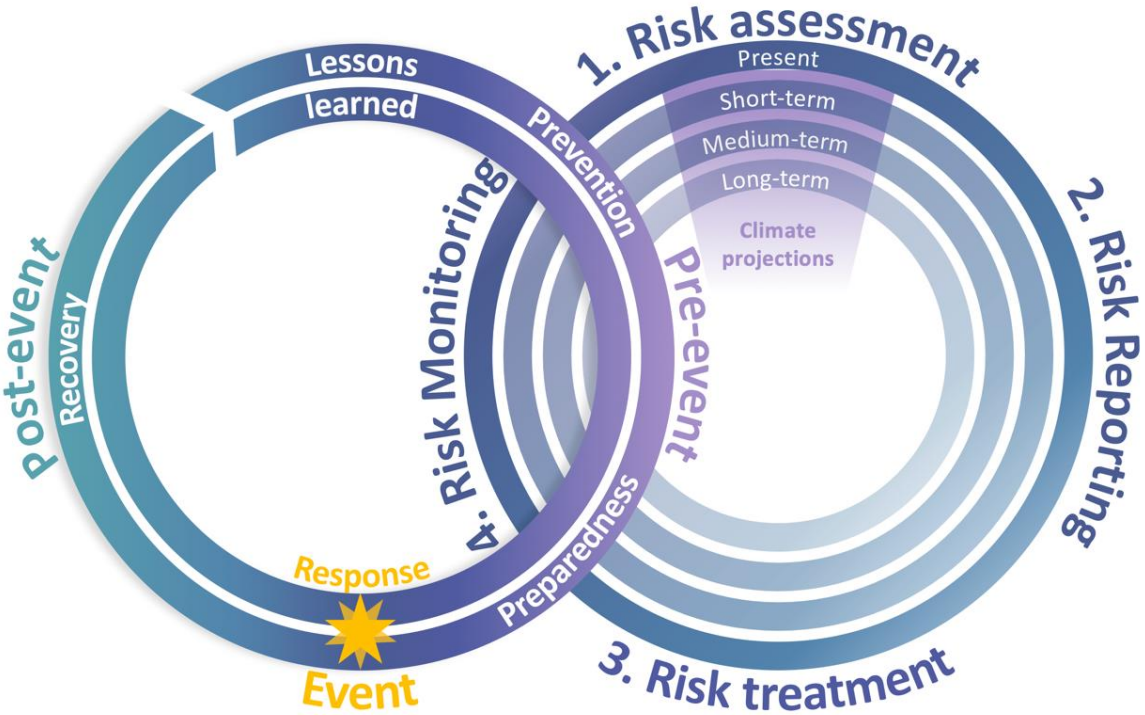


Figure 6. The climate risk management framework. The cycle on the left represents the stages of a climate-related crisis, while the cycle on the right represents the climate risk management framework itself, which should be applied proactively before an event takes place, informing prevention and emergency preparedness, and improving emergency response and recovery.

The **first cycle** represents the recurring nature of severe climate and weather events and the **general activities that should be undertaken at each pre-event, event and post-event stage**. Any lessons learned after a severe climate and weather event should feed into both prevention and emergency preparedness.

The **second cycle** represents the **climate risk management steps** that should be taken at the pre-event stage, namely **risk assessment, risk reporting, risk treatment and risk monitoring**. Central to this are **two main outputs: the risk report and the risk register**, which should provide a ranking of climate risks and the available options to treat such risks. Both outputs are used to inform decisions on prevention and emergency preparedness, and improve emergency response and recovery.

The risk assessment itself comprises three parts:

1. **Risk identification**: Identification of all significant sources of risk to create a comprehensive list of risks present in an organisation, its elements, missions and operations based on events (e.g. climate hazard) that may affect a risk.
2. **Risk analysis**: Determination of the risk of event scenarios by estimating the severity of potential consequences, or impacts, and the likelihood. The result of the risk analysis feeds into the risk evaluation and treatment steps.
3. **Risk evaluation**: Comparison of the calculated risk level with risk acceptability criteria to support decision-making.

Risk assessments should be comprehensive, account for all climate hazards that may affect an organisation, its elements, missions and operations, but should also look into how short-, medium- to long-term climate projections may influence the climate hazards (e.g., location, duration, intensity and frequency). Both high-impact low-probability and low-impact high-probability events should be considered. In risk assessment, risk matrices and a risk register should be produced (see Box 6). **Risk assessments should be continuously updated** based on new available information, and risk treatment decisions should be adjusted accordingly.

Risk reporting is where the risk assessment is documented. A risk report provides a structured analysis of current risks and their evolution according to different climate projections, or scenarios. It includes elements such as a detailed description of objectives, scope, relevant background information, methodology, key findings, conclusions and recommendations, offering decision-makers the needed insights to proactively reduce risk and strengthen resilience.

Risk treatment is where the decision to implement certain measures for reducing risk are made. Risk treatment should be targeted based on the insights of the risk assessment and on considerations regarding cost-effectiveness and risk acceptability. For example, Chiefs of Defence Staff may find that some elements of the organisation are in critical need of more climate-proofing, more fault tolerance or even relocation, as their failure may lead to unacceptable loss and damage, or may compromise operational effectiveness and readiness.

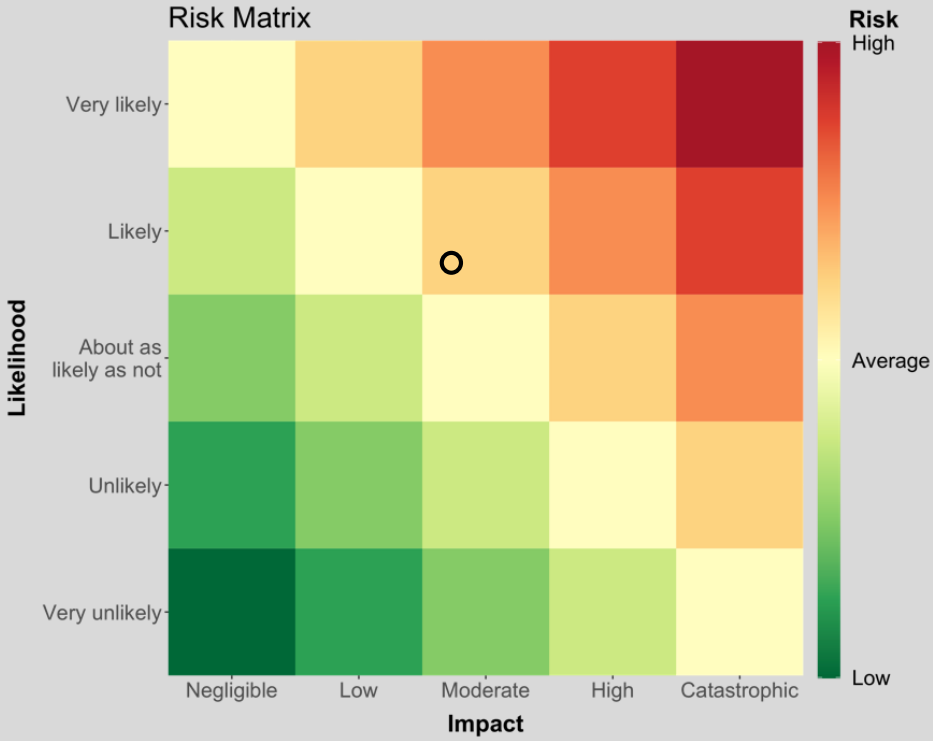
Risk monitoring is where risk reduction measures that were decided to be implemented are checked for their implementation progress and for their effectiveness in reducing risk and strengthening resilience.

For this climate risk framework to be effective, **Chiefs of Defence Staff need to actively support its use and commit to implement it, and its outcomes, across all departments and functions of their organisation. This implies making the necessary resources, training and mandates available to staff**.

Chapter 8 of this guide helps Chiefs of Defence Staff to navigate through the implementation of a climate risk framework in their organisation.

Box 6. Risk matrix, risk ratings, risk maps and risk register.

The impact/consequence versus likelihood plot, commonly known as **risk matrix**, is a tool used in risk management to visually represent, understand and communicate risks based on their estimated likelihood of occurrence and the severity of potential consequences, or impacts. An example of a risk matrix is provided below. The graphical representation is colour-coded to indicate the significance of the risk (see risk rating below), and can provide a view of the risk level of the organisation, its elements, missions and operations. In the defence context, a risk matrix can be used to analyse a specific group of persons, a set of components (e.g., power generators), a system (e.g., a military microgrid), an asset (e.g., a frigate, a battalion), a military installation (e.g., headquarters), a particular military operation or the MoD as a whole. Establishing common scales for the risk matrix is crucial to harmonise its use across different MoDs, departments of the armed forces or across functions. However, it should be noted that risks associated with different categories of consequences, or impacts, have unique characteristics and cannot be easily combined.



Risk ratings indicate the significance of risk and correspond to specific placements (e.g., dark circle in the figure above) and colours within the risk matrix. Risk ratings enable risk prioritisation and informed decisions regarding the implementation of risk reduction measures. Such measures aim to bring a specific risk rating to a level that is considered acceptable. Risk ratings could also be used to inform emergency preparedness, for example knowing which assets are at risk is useful to pre-emptively move them to a safer location, pre-deploy resources such as spare parts, and focus response and recovery efforts. It is important to note that climate risks are inherently dynamic due to natural factors and the emission of GHG from human activities, which are in turn influenced by policy decisions, technological innovations and societal responses, changing vulnerability and resilience, and scientific advancements. Thus, the temporal dimension of risk ratings should be taken into account.

A **risk map**, is a geographical representation of the risk rating of the organisation, its elements, missions and operations within a specific area. It typically uses the same colour-coding as in the risk matrix to show the likelihood of a potential impact/consequence, further helping to prioritise and implement risk reduction measures. Risk maps could also be used to inform emergency preparedness, for example by helping to define the safest evacuation routes or shelter deployment sites.

A **risk register** is used as a repository for registering, analysing and controlling risks. Within the risk register, each risk is described in detail, including sources of risk, risk projections, possible outcomes, identified interdependencies among different systems, hazards or events and any knock-on effects they may trigger. It also captures the planned and existing risk treatment, early signs of occurrence of a particular risk and the consequences when a risk treatment fails. The register includes a statement detailing the impact/consequence and its likelihood, which can be represented using a risk matrix. Risks are prioritised based on their significance, considering the probability of the risk treatment failing. This helps decision-makers to allocate resources efficiently to reduce risk or strengthen resilience, focusing on the most critical risks first. It also helps to track the implementation of risk treatment and assess its effectiveness. The risk register contents should be iteratively updated as new risk analysis and new information from incident investigations become available.

COMPREHENSIVE RISK ASSESSMENT, DILIGENT REPORTING, EFFECTIVE RISK TREATMENT AND CONTINUOUS MONITORING FORM THE BACKBONE OF INFORMED DECISION-MAKING. THIS APPROACH IS CRUCIAL TO EQUIP THE ARMED FORCES WITH THE KNOWLEDGE AND TOOLS NEEDED TO RESPOND TO AND ADEPTLY MANAGE CLIMATE RISKS, ENSURING READINESS AND RESILIENCE IN THE FACE OF CLIMATE-RELATED CHALLENGES

7. Communicating Climate Risk and Inspiring a Risk Culture

Communication both within an organisation and with external stakeholders is key throughout the entire timeline of a climate hazard, encompassing the stages before, during and after a climatic event. It is particularly important that individuals at all levels of an organisation understand risks and recognise their roles and responsibilities in the risk management process, particularly the risks that are specific to their workplaces and the appropriate response actions to be taken. Defence staff must also be involved in emergency planning.

Overall, the aim of risk communication is to drive awareness and inspire a risk culture in the organisation. In this context, Chiefs of Defence Staff shall assume responsibility for establishing a strategy for risk communication. This strategy should acknowledge the need to maintain continuous two-way open and transparent communication within the organisation and with external stakeholders, including defence contractors and those operating critical infrastructure.

Particular attention should be given to vulnerable groups that are disproportionally affected by climate impacts, as highlighted in the *Joint Communication on the climate-security nexus* of June 2023 ([6]). In this regard, all climate risk assessments and climate risk management decisions should strive to be equitable and inclusive, but also gender-responsive.

Chiefs of Defence Staff should also ensure that the developed climate risk management policy is communicated to all relevant parties. Furthermore, they shall exercise risk oversight and ensure that roles, responsibilities and authority in risk management are assigned and communicated. They should also approve criteria for adequate risk reporting, including level of detail and data aggregation, depending on the recipients, and ensure that the integrity of documented information and data protection are safeguarded. Most importantly, **documented information shall be controlled and classified appropriately to avoid revealing vulnerabilities to adversaries**.

Leadership obligations should extend to:

1. **Comprehensive climate hazard awareness**: Being aware of the full spectrum of climate hazards and impacts of relevance for a specific site, how they may affect staff, security, safety, operational readiness and effectiveness, and what the possible consequences, including to communities in the vicinity of military installations, would be;
2. **Inspiring a risk-aware culture**: Implementing a risk communication strategy to drive risk awareness across the organisation and inspire a risk culture;
3. **Effective climate risk management implementation**: Ensuring the implementation of a climate risk management policy, risk reports and risk registers, early warning and alert systems, and emergency plans, including emergency communications.

EFFECTIVE CLIMATE RISK COMMUNICATION AND A STRONG RISK CULTURE ARE VITAL FOR DEFENCE RESILIENCE AND SUSTAINABILITY. THE LEADERSHIP'S ROLE IS NOT ONLY TO BE AWARE OF CLIMATE HAZARDS, BUT ALSO TO INSPIRE A CULTURE OF RISK AWARENESS AND ENSURE PROPER CLIMATE RISK MANAGEMENT GOVERNANCE

8. Leading the Way in Climate Risk Management

The imperative for Chiefs of Defence Staff to address the challenges posed by climate change in their organisation has never been more pronounced. As we navigate an era defined by unprecedented environmental shifts, it falls upon Chiefs of Defence Staff to ensure that there are sufficient safeguards in place to protect their organisations, missions and operations against complex climate impacts, and that appropriate climate action is taken to position their organisation at the forefront of climate resilience and long-term sustainability.

This Section guides Chiefs of Defence Staff in effectively implementing the climate risk management framework. **Chiefs of Defence Staff are challenged to stay abreast of evolving climate risk, implement robust climate risk governance across their organisation, find the necessary resources for technical analyses, ensure the significance of outcomes by taking action and exercise oversight.**

For effective climate risk management, Chiefs of Defence Staff should:

1. Build-up their general knowledge of climate impacts and climate risk.
2. Make sure they understand the benefits and threats of taking a proactive versus a reactive approach, or even no approach at all, to manage climate risk in their organisation.
3. Decide to implement climate risk management across their organisation, using the framework in this guide, adapting it, or developing their own.
4. Define the scope and context of application of the climate risk management framework (see Figure 3).
5. Decide upon the best way to manage climate risk in their organisation, i.e., the climate risk governance structure, of which options include:
    a. Creating the role of Chief Risk Officer (CRO) and appointing a person to be in charge of managing risk, including climate risk, across the whole organisation, establishing and leading multidisciplinary teams composed of staff members or externals, as needed, with well-defined roles and tasks, resources, tools and authority to analyse and propose measures for addressing risk. The CRO would also be in charge of liaising directly with Chiefs of Defence Staff and external stakeholders (e.g., public authorities with competence in relevant fields);
    b. Alternatively, assigning the role of Climate Risk Manager to existing staff member(s) directly, which would on top of their current tasks (e.g., Environmental Officer) perform climate risk management tasks. This option would still need well-defined roles and tasks, resources, tools and appropriate authority. Here, the multidisciplinary team would consist of staff members (if more than one is assigned);
    c. Outsourcing climate risk management entirely or partially to external experts from public authorities, international organisations or the private sector.
6. Make sure that technical staff assigned to a role in climate risk management has the appropriate knowledge and skills, or the training opportunities to develop them, as well as the possibility to pursue relevant certifications and/or qualifications.
7. Ensure that the climate risk governance structure has the authority to:
    a. Perform all climate risk management steps (risk assessment, risk reporting, risk treatment and risk monitoring);
    b. Produce deliverables such as risk reports, risk registers, risk maps, adaptation plans and strategies (e.g. climate change and defence strategy);
    c. Propose changes to policies, procedures, standards, etc., where gaps are identified;

d. Propose an action plan to improve prevention and emergency preparedness and implement risk treatment measures;
e. Define triggering levels for different emergency response actions, if possible linked to existing early warning systems;
f. Conduct training to improve emergency preparedness, including table-top and field exercises;
g. Propose a command-structure for emergency response and recovery and make sure there is enough trained staff at all times to perform such actions;
h. Conduct or participate in inspections relevant to climate-related impacts, including safety, adequacy and functioning of emergency power systems, emergency response equipment, etc.;
i. Liaise with relevant external stakeholders, such as public authorities responsible for risk assessment, civil protection and early warning, operators of critical infrastructure, etc.;
j. Raise awareness about climate risk and climate action in the organisation and disseminate the lessons learned from previous climate-related events.

8. Ensure the availability of the needed resources, tools, appropriate authority and access rights to collect information and conduct climate risk assessments in the organisation, its elements, missions and operations.
9. Define the climate risk management team's key targets, key performance indicators, deliverables (e.g., risk report, risk register, risk maps etc.) and reporting timeframe.
10. Ensure that deliverables are clear and comprehensive, tailored to each specific element of the organisation, consistent with regional or national risk assessments, use the best available knowledge, are up-to-date and easily accessible to senior leadership and relevant staff.
11. Require that uncertainty associated with the risk analysis and proposed risk treatment is considered in decision-making.
12. Decide, after consultation with relevant departments or functions, the risk acceptability criteria for the organisation, its elements, missions and operations, based on the outcomes of the climate risk analysis summarised in the risk report.
13. Decide on the implementation of a climate risk management action plan and on the allocation of the needed resources, making cost-benefit considerations.
14. Oversee climate risk governance, the implementation of actions, and the effectiveness of risk treatment, emergency response and recovery in case of a severe weather or climate event.
15. Integrate climate change considerations into decision-making and budgeting processes at all organisational levels, and across departments and functions.
16. Facilitate an equitable risk culture in the organisation, enabling effective (open) risk communication, including the discussion of lessons learned and the identification of risks in the workplace, inclusive of vulnerable groups and gender-specific risks.
17. Make sure that all climate risk information is classified appropriately to avoid revealing vulnerabilities to adversaries.

CHIEFS OF DEFENCE STAFF MUST ESTABLISH STRONG CLIMATE RISK GOVERNANCE AND SECURE RESOURCES TO BOLSTER ORGANISATIONAL RESILIENCE AGAINST THE COMPLEX IMPACTS OF CLIMATE CHANGE

9. Conclusions

In a time marked by intensifying climate hazards and rapidly changing operating conditions, the need to effectively manage climate risk has never been more crucial. The recommendations for action outlined in this guide should help Chiefs of Defence Staff to successfully navigate the intricate landscape of climate risk management.

By comprehensively embracing climate action and **integrating climate considerations across their organisation, Chiefs of Defence Staff can strengthen resilience, avoid harm to staff and future financial losses, and seize a strategic advantage**. This entails working in parallel towards the crucial goal of reducing GHG emissions (i.e., addressing the root-cause of climate change) and towards fostering a risk culture, complementing the adaption measures already in place or to be undertaken. Furthermore, by proactively engaging in mitigation efforts, **the armed forces can lead by example in energy efficiency and environmental protection, demonstrating their commitment to sustainable practices**.

As **climate risk management aligns with strategic objectives** and seamlessly integrates into organisational processes, Chiefs of Defence Staff also lay the foundation for increased energy security, resilience and sustainability. In driving their staff towards climate action and by using procurement as a catalyst of change in the defence industry, Chiefs of Defence Staff exert a transformative influence, forging a path towards more capable and energy-autonomous armed forces.

The significance of this guide is underscored by the included Annex, which provides a **checklist for Chiefs of Defence Staff to evaluate their organisation's readiness and ability to effectively manage climate risk**. This self-assessment covers the following **six key areas**:

1. **Risk awareness** (understanding climate change impacts);
2. **Leadership and risk culture** (proactive management, roles and responsibilities);
3. **Risk information** (accessibility, accuracy, decision-making processes);
4. **Risk management expertise** (assessment capabilities, staff training, skill development);
5. **Prevention and risk treatment** (adaptation and mitigation strategies, contingencies);
6. **Emergency response and recovery** (assessments, plans, resource allocation, resilience, effectiveness).

This comprehensive self-assessment helps Chiefs of Defence Staff to identify their organisation's strengths and areas for improvement in managing climate risk. By conducting this self-assessment, identifying and closing gaps and implementing at the national level, they enhance the climate-proofing of EU defence and bolster the EU's adaptation capacity to climate change, while strengthening energy resilience and autonomy.

IN A TIME OF ESCALATING CLIMATE RISKS, CHIEFS OF DEFENCE STAFF CAN LEAD BY EXAMPLE, STRENGTHENING RESILIENCE, REDUCING LOSSES AND DRIVING TRANSFORMATION. THIS GUIDE EMPOWERS THEM TO INTEGRATE CLIMATE ACTION, REDUCE EMISSIONS, FOSTER A RISK CULTURE AND ENHANCE READINESS

References

EDA, Enhancing EU Military Capabilities Beyond 2040 – Main findings from the 2023 Long-Term Assessment of the Capability Development Plan, 2023. https://doi.org/10.2836/360180

Hellenic Republic Ministry of National Defence, Climate Change Adaptation and Mitigation Roadmap of the Armed Forces, 2023.

IPCC (2021). Climate change 2021: The physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, edited by: Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S. L., Péan, C., Berger, S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M. I., Huang, M., Leitzell, K., Lonnoy, E., Matthews, J. B. R., Maycock, T. K., Waterfield, T., Yelekçi, O., Yu, R. and Zhou, B., Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK and New York, US. https://www.ipcc.ch/report/ar6/wg1/

ISO 31000:2018, Risk management – Guidelines.

ISO 14091:2021, Adaptation to climate change – Guidelines on vulnerability, impacts and risk assessment.

Krausmann, E. and Necci, A., Thinking the unthinkable: A perspective on Natech risks and Black Swans, Safety Science 139, 105255, 2021. https://doi.org/10.1016/j.ssci.2021.105255

Ministère des Armées, Climate & Defence Strategy, 2022.

Ministerio de Defensa, The Ministry of Defence's Strategy on the challenge of Climate Change, 2023.

Necci, A. and Krausmann, E., Natech risk management – Guidance for operators of hazardous industrial sites and for national authorities, EUR 31122 EN, Publications Office of the European Union, Luxembourg, 2022, JRC129450. https://doi.org/10.2760/666413

Tavares da Costa, R., Krausmann, E. and Hadjisavvas, C., Impacts of climate change on defence-related critical energy infrastructure, EUR 31270 EN, Publications Office of the European Union, Luxembourg, 2023, JRC130884. https://doi.org/10.2760/03454

Zachariah, M., Philip, S., Pinto, I., Vahlberg, M., Singh, R., Otto, F., Barnes, C. and Kimutai, J., Extreme heat in North America, Europe and China in July 2023 made much more likely by climate change, Grantham Institute for Climate Change, 2023. https://doi.org/10.25561/105549

Annex

Annex 1. Checklist for Defence Leaders

Table A.1. Self-assessment questions for Chiefs of Defence Staff: Risk awareness.

	Risk awareness	Yes	Not sure	No
1	Are you aware of the specific challenges posed by climate change to your organisation's staff, installations, capabilities, missions and operations?			
2	Are you aware of the vulnerabilities of your organisation's staff, installations, capabilities, missions and operations to climate change?			
3	Are you aware of the vulnerabilities that external critical infrastructure and supply chains, which your organisation depends upon, may have to climate change?			
4	Are you aware how climate hazards are projected to change in the locations where you operate?			
5	Can you tell to which level, and within which timeframe, climate change may threaten your organisation's staff, installations, capabilities, missions and operations?			
6	Is your organisation's climate risk management policy communicated to all relevant staff, so that they take ownership of the risk?			
7	Does your organisation provide regular targeted training and resources to help staff recognise and understand climate risk?			
8	Is staff across your organisation familiar with climate risks in the workplace, including with technological accidents that may be triggered by climate hazards?			
9	Does staff across your organisation understand the rationale behind the need for incident prevention, preparedness and response measures to be in place?			
10	Does staff have appropriate channels to report and discuss risks they identify at the workplace?			

Table A.2. Self-assessment questions for Chiefs of Defence Staff: Leadership and risk culture.

	Leadership and risk culture	Yes	Not sure	No
1	Do you think your organisation is resilient to evolving climate risk?			
2	Do you think a proactive risk culture that prioritises incident prevention and emergency preparedness is advantageous?			
3	Do you prioritise anticipatory risk management over reactive crisis management when pursuing your organisation's core tasks?			
4	Is risk management part of strategic planning in your organisation?			
5	Are roles, responsibilities and authority in risk management assigned and communicated?			
6	Are the gender dimension and the needs of vulnerable groups adequately represented in the risk management decision-making process?			
7	Are climate risk management key targets and key performance indicators established and communicated to relevant staff?			
8	Is climate risk management considered in inspections and audits?			
9	Do you have a risk management policy that incorporates different climate projections and/or climate scenarios?			
10	Is a culture of openness and transparency in communicating risk promoted across the organisation?			

Table A.3. Self-assessment questions for Chiefs of Defence Staff: Risk information.

	Risk information	Yes	Not sure	No
1	Is risk information easily accessible to Chiefs of Defence Staff for decision-making?			
2	Is climate risk information used for decisions across departments and functions of your organisation, such as in procurement, siting, design, operations, etc.?			
3	Do you consider climate risk information over the short, medium and long term in your decision making?			
4	Does your organisation have a risk register to consolidate information about the various types of risks it faces?			
5	In case of incidents, are climate hazards clearly reported as a (contributing) cause of impacts?			
7	Does your organisation have a process to learn from past incidents, including those relevance from outside of your organisation?			
8	Are risk assessments consistently and systematically documented and updated regularly based on the latest science and information such as lessons learned?			
9	Does your organisation participate in knowledge exchange with relevant experts to improve the understanding of climate risk and its evolving nature?			
10	Where appropriate, does your organisation share the lessons learned from past incidents with external stakeholders?			
11	Does your organisation control and classify risk information appropriately to avoid revealing vulnerabilities to adversaries?			

Table A.4. Self-assessment questions for Chiefs of Defence Staff: Risk management expertise.

	Risk management expertise	Yes	Not sure	No
1	Does your organisation have the capabilities and competences to implement effective climate risk management?			
2	Does your organisation foster continuous learning to adapt to evolving climate risk?			
3	Does your organisation arrange for targeted training or workshops to enhance competencies in climate risk management?			
4	Is staff encouraged to pursue relevant certifications and/or qualifications in risk management?			
5	Does your organisation have appropriate guidance to conduct climate risk assessments?			
6	Do staff have guidelines for identifying, reporting and responding to risks relevant to their roles and workplace?			
7	Are risk management teams in your organisation multidisciplinary?			
8	Does your organisation arrange for immersive training experiences, such as table-top exercises, to enhance employees' skills in emergency response and recovery?			
9	Are there secondment programs that pair designated staff with experienced risk management professionals to enhance their skills?			
10	Does your organisation collaborate with academic or research organisations to stay updated on the latest science?			

Table A.5. Self-assessment questions for Chiefs of Defence Staff: Prevention and risk treatment.

	Prevention and risk treatment	Yes	Not sure	No
1	Do you ensure that you organisation's activities and practices are consistent with climate change adaptation and climate change mitigation?			
2	Are regular risk assessments conducted across your organisation?			
3	Are risk assessment approaches consistent across your organisation's departments and functions?			
4	Are risk assessments in your organisation coherent with existing national and regional risk assessments and climate projections?			
5	Do you think that resources allocated for climate risk management and resilience building are sufficient in your organisation?			
6	Do you make use of your organisation's in-house expertise to enhance risk assessments (e.g., Weather Officers)?			
7	Has your organisation implemented physical measures to prevent or control consequences (e.g., flood defences, redundant emergency power) associated with climate hazards?			
8	Does your organisation diversify energy sources and suppliers to prevent external disruptions or has contingencies in case of disruptions?			
9	Does your organisation incentivise and recognise employees who identify potential risks before they escalate?			
10	Has your organisation employed scenario building techniques (e.g., red teaming, scenario planning) to uncover potential climate vulnerabilities?			

Table A.6. Self-assessment questions for Chiefs of Defence Staff: Emergency response and recovery.

	Emergency response and recovery	Yes	Not sure	No
1	Are you confident that your organisation is able to maintain critical functions during a crisis?			
2	Does your organisation have emergency response and business continuity plans?			
3	Are emergency response and business continuity plans regularly reviewed?			
4	Are climate hazards considered in emergency planning and exercising?			
5	Are technological accidents involving dangerous substances, including their possible triggering due to climate hazards, considered in emergency planning and exercising?			
6	Are cascading effects considered in emergency planning and exercising?			
7	Does your organisation cooperate with public authorities, critical infrastructure operators and supply chain stakeholders, to optimise emergency response and recovery?			
8	Does your organisation have the means to communicate and coordinate with different external stakeholders during climate-related crises, when normal communication channels are down?			
9	Do you think your staff is adequately trained to effectively respond to and help your organisation effectively recover from a climate-related crisis?			
10	Does your organisation have early warning and alert systems in place for climate hazards?			

List of abbreviations

AMOC	Atlantic Meridional Overturning Circulation
AMO	Atlantic Multi-decadal Oscillation
CER	Critical Entities Resilience
CH_4	Methane
CI	Critical infrastructure
CO_2	Carbon dioxide
EC	European Commission
EDA	European Defence Agency
EEAS	European External Action Service
ENSO	El Niño–Southern Oscillation
ESA	European Space Agency
ESG	Environmental, Social and Governance standards
EU	European Union
GHG	Greenhouse gas
GWP	Global warming potential
JRC	European Commission Directorate-General Joint Research Centre
MoD	Ministry of Defence
NAO	North Atlantic Oscillation
NATO	North Atlantic Treaty Organization
N_2O	Nitrogen oxide
OECD	Organisation for Economic Co-operation and Development
SC	Supply chain
SoS	System of systems
SF_6	Sulphur hexafluoride
TTX	Tabletop exercises

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[1] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Commission contribution to European defence, COM/2022/60 final. HYPERLINK "https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52022DC0060"

[2] Council of the European Union. Council Conclusions on Security and Defence, 17 June 2020, 8910/20. https://www.consilium.europa.eu/media/44521/st08910-en20.pdf

[3] European External Action Service. Climate Change and Defence Roadmap, EEAS(2020) 1251. European External Action Service, Brussels. https://data.consilium.europa.eu/doc/document/ST-12741-2020-INIT/en/pdf

[4] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Commission contribution to European defence, COM/2022/60 final. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52022DC0060

[5] Council of the European Union. A Strategic Compass for Security and Defence – For a European Union that protects its citizens, values and interests and contributes to international peace and security, 21 March 2022, 7371/22. https://data.consilium.europa.eu/doc/document/ST-7371-2022-INIT/en/pdf

[6] European Commission and High Representative of the Union for Foreign Affairs and Security Policy/Vice-President of the European Commission. Joint communication to the European Parliament and the Council, a new outlook on the climate and security nexus: addressing the impact of climate change and environmental degradation on peace, security and defence, JOIN(2023) 19 final. https://www.eeas.europa.eu/eeas/joint-communication-climate-security-nexus_en

[7] Directive (EU) 2022/2557 of the European Parliament and of the Council of 14 December 2022 on the resilience of critical entities and repealing Council Directive 2008/114/EC. https://eur-lex.europa.eu/eli/dir/2022/2557/oj

[8] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Forging a climate-resilient Europe - the new EU strategy on adaptation to climate change, COM/2021/82 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2021%3A82%3AFIN

[9] Copernicus Climate Change Service (C3S). Climate indicators – Temperature. https://climate.copernicus.eu/climate-indicators/temperature

[10] Copernicus Climate Change Service (C3S). Climate indicators – Greenhouse gas concentrations. https://climate.copernicus.eu/climate-indicators/greenhouse-gas-concentrations

[11] The Guardian, 2023. Gulf Stream could collapse as early as 2025, study suggests. https://www.theguardian.com/environment/2023/jul/25/gulf-stream-could-collapse-as-early-as-2025-study-suggests

[12] Euronews, 2023. Wildfire in Greece triggers explosions at an ammunition depot and the relocation of fighter jets. https://www.euronews.com/embed/2332280

[13] European Commission Joint Research Centre, 2023. Severe drought: western Mediterranean faces low river flows and crop yields earlier than ever. https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/severe-drought-western-mediterranean-faces-low-river-flows-and-crop-yields-earlier-ever-2023-06-13_en

[14] BBC, 2023. Greek fires at Nea Anchialos prompt blasts forcing F-16s to evacuate base. https://www.bbc.com/news/world-europe-66334787

[15] Οικονομικός Ταχυδρόμος, 2023. Νέα Αγχίαλος: Το πόρισμα για την φωτιά στην αποθήκη πυρομαχικών της 111 Πτέρυγας Μάχης. https://www.ot.gr/2023/08/04/epikairothta/nea-agxialos-to-porisma-gia-tin-fotia-stin-apothiki-pyromaxikon-tis-111-pterygas-maxis/

[16] ABC News, 2023. Wildfire in Greece triggers explosions at an ammunition depot and the relocation of fighter jets. https://abcnews.go.com/International/wireStory/greek-wildfires-reach-outskirts-athens-eu-agency-records-101710784

[17] Reuters, 2023. Greece PM says climate change 'not an excuse' as wildfires burn. https://www.reuters.com/world/europe/firefighters-battle-greece-wildfires-overnight-farms-factories-burn-2023-07-27/

[18] ERT News, 2023. Εφιαλτικές στιγμές στη Νέα Αγχίαλο μετά τις εκρήξεις σε αποθήκη πυρομαχικών – Ανακοίνωση ΓΕΑ. https://www.ertnews.gr/eidiseis/ellada/efialtikes-stigmes-sti-nea-agxialo-meta-tis-ekrikseis-se-apothiki-pyromaxikon-anakoinosi-gea/

[19] Kathimerini, 2023. Nea Anchialos blast: Administrative inquiry unveils negligence. https://www.ekathimerini.com/news/1217092/nea-anchialos-blast-administrative-inquiry-unveils-negligence/

[20] Kathimerini, 2023. Questions loom over air base's security. https://www.ekathimerini.com/news/1216698/questions-over-air-bases-security-loom/

[21] Οικονομικός Ταχυδρόμος, 2023. Στοιχεία σοκ για τις εκρήξεις στο στρατόπεδο στη Νέα Αγχίαλο – Τι δείχνει το πόρισμα. https://www.ot.gr/2023/08/02/epikairothta/stoixeia-sok-gia-tis-ekrikseis-sto-stratopedo-sti-nea-agxialo-ti-deixnei-to-porisma/

[22] In, 2023. Nea Anchialos: "War zone" after the fire – Explosion, shock wave and evacuation by sea. https://www.in.gr/2023/07/28/english-edition/nea-anchialos-war-zone-fire-explosion-shock-wave-evacuation-sea/

[23] The Sun, 2023. BASE BLAST Moment Greek wildfire hit military ammunitions dump sparking huge fireball blast that turns sky blood red. https://www.thesun.co.uk/news/23220811/moment-greek-wildfire-hit-military-ammunitions-dump-fireball/

[24] Οικονομικός Ταχυδρόμος, 2023. Νέα Αγχίαλος: Σεισμός 1 Ρίχτερ από την έκρηξη στις αποθήκες πυρομαχικών. https://www.ot.gr/2023/08/02/epikairothta/koinonia/nea-agxialos-seismos-1-rixter-apo-tin-ekriksi-stis-apothikes-pyromaxikon/

[25] Οικονομικός Ταχυδρόμος, 2023. Στοιχεία σοκ για τις εκρήξεις στο στρατόπεδο στη Νέα Αγχίαλο – Τι δείχνει το πόρισμα. https://www.ot.gr/2023/08/02/epikairothta/stoixeia-sok-gia-tis-ekrikseis-sto-stratopedo-sti-nea-agxialo-ti-deixnei-to-porisma/

[26] Flash.gr, 2023. Νέα Αγχίαλος: Θραύσματα από τα εκρηκτικά σε εκατοντάδες μέτρα – Φωτό ντοκουμέντα. https://www.flash.gr/nea-agxialos-thraysmata-apo-ta-ekriktika-se-ekatontades-metra-foto-ntokoumenta-890196

[27] Kathimerini, 2023. F-16s being moved from Nea Anchialos airbase. https://www.ekathimerini.com/news/1216504/f-16s-being-moved-from-nea-anchialos-airbase/

[28] Stockholm Resilience Center. The nine planetary boundaries. https://www.stockholmresilience.org/research/planetary-boundaries/the-nine-planetary-boundaries.html

[29] Deloitte. Climate change is now a key strategic priority for the C-suite. https://www2.deloitte.com/us/en/insights/environmental-social-governance/corporate-sustainability-initiatives.html

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