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Climate.Changes.Security.

Navigating Climate Change and Security Challenges in the OSCE Region

Hans Lampalzer and Gerald Hainzl (eds.)

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in the OSCE Region

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Introduction

Foreword

The 2023 United Nations Climate Change Conference (COP28) in Dubai may have revealed more than one inconvenient truth, but also gave us hope. Progress regarding the implementation of the Paris Agreement is not what it should be, and the impact of climate change is becoming increasingly extreme. Ecosystems are disrupted and livelihoods destroyed, while resources dwindle, and new rivalries emerge. For the first time in history, however, an agreement was reached to transition away from fossil fuels.

But why do or should armed forces care about climate change? For the security sector, climate change is one of the greatest security threats and – above all – a risk multiplier and driver of conflicts. In recent years, the task of armed forces in the light of climate change has been described as a *dual obligation*, which means adapting to new challenges and reducing the ecological footprint. In 2022, the Austrian Federal Ministry of Defence addressed the climate-security nexus in its paper *Climate Change and Defence Policy* and set out concrete defence policy goals. This strategic document contributed to the climate-security nexus as part of a whole-of-government approach, because Austria has set itself the goal of climate neutrality by 2040. To maintain operational readiness, it is essential for our armed forces, especially in current times, to reduce their dependence on fossil fuels and develop resilience and self-sufficiency. Stabilisation of the Euro-strategic framework, awareness-raising and strategic foresight based on the concept of comprehensive security are further important steps towards the achievement of our goals.

The concept of comprehensive security dates back to the 1970s, when the OSCE took on a three-dimensional approach to security which encompasses the politico-military, the economic and environmental, as well as the human dimension. These three complement each other, are of equal importance and concern prosperity, stability and security. The fact that the OSCE is based in Vienna means that Austria has a special responsibility. The Austrian Ministry of Defence thus fully supports the OSCE's efforts to enhance dialogue and the exchange of information in the field of climate-related analysis.

I am delighted that the publication at hand has been realised in co-operation with the Austrian Federal Ministry for European and International Affairs.

The publication's articles on climate change and security are the result of the OSCE's call to work with the world of academia, representatives of civil society and other important stakeholders. This reflects the spirit of co-operation which is required to tackle climate change as a cross-sectional issue, because climate change requires joint efforts to mitigate and adapt to its effects.

Arnold Kammel,
Secretary General of the Federal Ministry of Defence

Foreword

The multiple crisis situations in Europe in these last years, from the COVID-19 pandemic to the Russian war of aggression against Ukraine, from climate change to migration/asylum, are reflected in surveys showing that citizens in many countries in Europe are increasingly concerned by global geopolitical developments and that a feeling of insecurity is on the rise.

Consequently, discussions in Europe today focus on concepts and solutions aiming at stabilisation, "de-risking" and reducing dependencies as well as at increasing security through "resilience" and "strategic autonomy". During the COVID-19 crisis, experts were concerned that the production of pharmaceuticals had moved out of Europe (e.g. paracetamol) and argued in favour of putting more emphasis (and investment) on security of supply in the future. After Russia's full-scale invasion in Ukraine, the focus of attention shifted to security and defence, with all Members States of the European Union investing in more robust security and defence architectures and with Sweden and Finland joining NATO. Russia's war of aggression also led to the disruption of international supply chains, from grain to energy, leading to questions regarding global food supply as well as the availability, storage, transformation, diversification and affordability of energy.

One major area of concern is climate change, not only when it comes to endangering the environment, but in particular its direct and indirect impact on national, regional and international security. Austria and Europe have witnessed several dramatic effects of climate change: extreme weather and climate conditions including droughts as well as floods, melting glaciers, impacts on agriculture, natural disasters resulting in damaged infrastructure as well as lives lost. Consequently, climate change and environmental sustainability were one of the key topics of the European Parliament elections in 2019 that led to ambitious climate goals on European level. Moreover, on a global level, experts have underlined the impact of climate change on extreme poverty, hunger and health, resulting in people being forced to leave their homes in search of food and water.

Given its global nature, climate change can only be dealt with effectively through international cooperation. I am therefore very grateful to the Austrian Federal Ministry of Defence for this joint initiative in which experts

have been asked to analyse and address the climate-security link in more detail. As an active partner in multilateral dialogue and host to more than 50 international organisations and institutions, Austria puts a particular emphasis on joint solutions to joint problems, including in the framework of the Organization for Security and Co-operation in Europe (OSCE).

Ambassador Nikolaus Marschik,
Secretary-General for Foreign Affairs

Preface Initiator and Editors

Why another scientific publication on climate change? Is there not sufficient scientific evidence to start implementing the necessary tangible, robust and sustainable measures to mitigate climate change and its effects?

We face an accelerating pace of climate-induced changes to our environment and thus our daily lives, escalating social, economic and health-related costs as well as the risk of these developments becoming irreversible. While an ever-growing and professional interdisciplinary global scientific community provides us with the diagnosis and a range of possible countermeasures, news about broken temperature records leaves the global public largely cold. For instance, as this publication was being finalised, scientific research confirmed that 2023 would go down in history as the hottest year on record (ECMWF, 2023). Yet, there is a high probability that this will not be the last such news.

As a result, the challenge seems to lie in the political sphere: what measures need to be taken and in what time frame? In fact, international negotiations and domestic climate policies usually revolve around these two fundamental questions: how much and how fast?

So why does the issue of climate change and security merit an additional scientific review of its risks, impacts and costs?

Firstly, the security sector itself contributes to climate change. Moreover, its impact is less well understood than that of other sectors. There is still very little research on the amount of annual greenhouse gases emitted by armed forces around the world. Estimates put the total military carbon footprint at approximately 5.5% of global emissions (Parkinson & Cottrell).[1] Furthermore, Russia's ongoing war against Ukraine is seen as a main accelerator in this regard.[2]

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[1] See as well below in this publication: Cottrell, Jalili, and Burbridge: The OSCE and Military Emissions: Next Steps and Mitigation of Greenhouse Gases. 2023.

[2] See below in this publication: Andrusevych: Climate Policy in the European Security Context: Implications of the Russian Aggression and Post-War Reconstruction and the Recovery of Ukraine. 2023.

Secondly, security as a global and human good is severely impacted by climate change. Not only is human security affected, there is a risk of massive shifts in the entire global ecosystem. This encompasses many areas of security, such as the environment and economy in general as well as energy, health, food, forest and water management, desertification, infrastructure, housing, migration and many more.

Thirdly, global challenges – or even threats – demand global responses. The Organization for Security and Co-operation in Europe (OSCE), the world's largest regional security organization, acknowledged the urgency of the matter in its landmark decision at the Stockholm Ministerial Council in December 2021 (OSCE, 2021). This decision, adopted by consensus, gave the Organization a mandate to continue to encourage its participating States to enhance their co-operation in mitigating and adapting to climate change and to intensify their concrete cross-border action. The OSCE's efforts thereby meet the need for multilateral approaches to counter a global threat to security.

Raising awareness of climate-related challenges and intensifying dialogue and cooperation – as envisaged in Council of Ministers Decision 3/21 (MC.DEC/3/21) – must start at the national level to be effective. Therefore, a joint publication by the Austrian Ministries of Defence and European and International Affairs seems logical. The Permanent Mission of Austria to the OSCE and the National Defence Academy have been working together for many years. Events as part of the Austrian Chairpersonships of the OSCE in 2017 and of the Forum for Security Co-operation in 2021 as well as regular personnel support are evidence of this.

The National Defence Academy has been dealing with the topic of climate and security for some time. Since 2010, it has organised joint seminars with the University of Natural Resources and Life Sciences as part of the lecture series *Global change and sustainability and their relevance to security policy*. Just last year, this seminar was also supported by the Permanent Representation of Austria to the OSCE and an expert from the OSCE's Office of the Coordinator of Economic and Environmental Activities. In December 2022, the Austrian Ministry of Defence published its National Policy on Climate Change and Defence. Among other objectives, raising awareness and deepening education on climate change, its security policy consequences and its effects on the armed forces was also explicitly assigned to the National De-

fence Academy. In this regard, this publication intends to contribute to national and multi-lateral efforts.

Today, climate change is a driver of conflict and a threat multiplier affecting many areas of life. These *"can exacerbate economic challenges and environmental degradation, which may negatively affect prosperity, stability and security in the OSCE area"* (OSCE, 2021). MC.DEC/3/21 as well as the manifold programmatic activities of the OSCE's Office of the Coordinator of Economic and Environmental Activities, the Field Operations and the Economic and Environmental Committee, provide the impetus and framework for the publication at hand. To illustrate the diverse effects of climate change, national and international experts from the OSCE participating States were asked to share their expertise and views. As women and girls are often among the groups most vulnerable to the adverse impacts of climate change, the authors were particularly asked to give due consideration to gender-specific aspects where deemed appropriate.

Chapter 1 provides the background for the publication. The latest scientific findings on climate change, political developments and assessments are highlighted, as is the link between greenhouse gases and the role of the military. Despite clear evidence of climate change, the factor of disinformation must not be underestimated. It is on the rise, *inter alia*, in the form of climate denialism, which falsely states that there is no man-made climate change (iep. 2023). In May 2023, the 28 organisations contributing to the European Digital Media Observatory (EDMO) fact-checking network revealed that 12% of 1,361 articles checked focussed on climate change-related disinformation, a figure which even exceeded disinformation on Ukraine (11%). Therefore, a historical perspective presents the difference between the two "*climate-change"* phenomena – "*natural climate change"* and "*man-made (anthropogenic)"* climate change.

Chapter 2 focuses on impacts of climate change on different regions. Five international experts provide their views on the Middle East and North Africa (MENA) region, South-Eastern Europe, the Dniester River basin shared between the Republic of Moldova and Ukraine, Ukraine and Central Asia. The geographical diversification offers insight into some very different challenges related to climate change: Why is the MENA region, including the six Mediterranean Partners for Co-operation, highly vulnerable to further warming effects? Why are proactive approaches regarding mitigation, adaptation

and migration governance needed so much? Which results can we observe in the co-operation between the OSCE and a Berlin-based think tank in the Shar/Šara Mountains and the Korab Massif area in South-Eastern Europe? What are the local, national and regional impacts on water management and biodiversity in the Dniester River basin between the Republic of Moldova and Ukraine? What are the implications of the Russian aggression on climate and security policies in Ukraine? A final view is dedicated to Central Asia. It discusses, *inter alia*, regional impacts on water and energy management and how inclusion of women in decision-making processes can provide appropriate measures to tackle the climate crisis.

A multitude of perspectives is offered in Chapter 3, which explains how climate change affects various sectors. A team of experts, bringing together three Austrian research institutions and universities, highlight the challenges and opportunities in facilitating the transition of Austria's electricity system towards a safe and sustainable future. An expert of the Austrian Armed Forces describes the role of the Military Geoservices in preparing the Armed Forces in times of climate change. Austria's leading environmental organisation, Global 2000, provides insights into why security is a key issue for civil society. Finally, a classic security topic from the politico-military dimension – land mines – authored by an international team of experts sheds light on the long-term legacy of explosive ordnance on climate change.

The willingness to co-operate was not only the unifying principle behind the founding of the OSCE, but it is also an essential prerequisite for such a publication. Therefore, we would like to express our sincere gratitude to the team of skilled experts willing to share their expertise and insights. Short CVs of all authors can be found at the end of the publication. In addition, we thank Ms Eva Widhalm, responsible Desk Officer in the Defence Policy and Strategy Division of the Ministry of Defence for sharing her rich expertise and all colleagues at the National Defence Academy, in particular Ms Heidemarie Lenz, Sergeant Lorenz Sack, Ms Ruža Marie Groffmann, Colonel Robert Romano and Mr Werner Pack, for their editing, administrative and technical support. This publication would not have been possible without their contribution.

Florian Raunig, Initiator, & Hans Lampalzer, Gerald Hainzl, Editors

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Chapter 1

Climate.Changes.Policy.

Impacts of Climate Change: An Overview

The State of Climate and Security: An Overview

Raquel Munayer, Sinéad Barry, Beatrice Mosello

As a defining challenge of the 21st century, the climate crisis has expanded the scope of international security, spurring the development of a growing field of academia and policy dedicated to understanding and addressing climate-related security risks. There is increasing evidence of how climate change and security challenges interact and exacerbate one another, especially in already fragile and conflict-affected contexts. Institutional responses have emerged to address these complex and multidimensional challenges, with leading organizations now more likely to integrate approaches to climate and security. This chapter provides an overview of key debates and emerging practices in this field and analyses some of the emerging practices as well as remaining gaps to address climate-related security risks.

Introduction

Among all the collective challenges that society must confront in the 21st century, few – if any – are as fundamental and existential as climate change. At the same time, that technology swiftly advances and unravels new ways for humans to learn, work and live, key resources that are needed for life, such as clean water and fertile soil, are rapidly disappearing. In addition to enormous suffering, especially for already marginalized people in fragile regions, climate change is also driving insecurity globally. According to the latest synthesis report by the Intergovernmental Panel on Climate Change (IPCC), climate change impacts contribute to violent conflict by undermining livelihoods and human security, leading to increasing human vulnerability, grievances and political tensions through several complex pathways (IPCC, 2023). However, the ways in which climate change drives insecurity

are subject to intense epistemological debate, as are the solutions to addressing climate-related security risks.[1]

Knowledge of these interactions has advanced significantly in the past decade. However, the urgency of designing and implementing the kind of policies and programs that are needed to address them has only recently started to become clear to policymakers and practitioners in the climate, development, humanitarian and security fields. In this light, the Organization for Security and Cooperation in Europe (OSCE) put out a Ministerial Council Decision in 2021 (OSCE, 2021a) encouraging its participating States to raise awareness of, mitigate and adapt to these challenges, embed them into national policies, and leverage cooperation as an effective path towards addressing climate-related security risks.

To support these efforts, and as climate change becomes further entrenched in the security domain, this chapter presents an analysis of the current state of the climate security debate and practice; it also reviews some of the responses that have been put in place to address these complex dynamics and reflects on what gaps remain, with a view to helping policymakers and practitioners at different levels to more easily identify entry points for integrated climate security interventions.

Risky interactions

Climate security risks are not just future risks. They are already visible today and are projected to increase (Detges et al., 2020; UNDP, 2020; IPCC, 2023). Since the first academic studies on climate and conflict links in the 1990s, there has been substantial research exploring the impacts of climate change on security (Mosello et al., 2020b). While at the beginning the primary focus

[1] To date, language around climate and security does not explicitly include broader environmental impacts. This likely has to do with the fact that environmental impacts are often a consequence of climate change, such as when extreme temperatures and droughts lead to the degradation of soil, landscapes and ecosystems, therefore being subsumed under climate change. However, environmental impacts can also occur via direct human influence, such as via pollution, deforestation or in the context of war and conflicts (see: Lukas Rüttinger et al., 2022). In this paper, we use the commonly accepted and widespread terminology around *climate security* and *climate-related security risks* to also include broader environmental risks.

was on uncovering the direct effects of climate change impacts on conflict, research has gradually moved towards looking at indirect impact pathways and cascading risks (Busby, 2018). Today, there is a substantial body of literature examining the conditions under which slow and fast onset climate impacts – such as rising temperatures and extreme weather events, respectively – affect the livelihoods of vulnerable communities, change migratory and transhumance patterns, and challenge the basic structures, cohesiveness and capacities of human societies (Detges et al., 2020).

While research methods and foci differ, researchers mostly agree that the links between climate change and security risks are indirect, non-linear, and overall complex. In other words, climate change impacts act as risk multipliers, interacting with other political, social, and economic stressors to compound existing situations of vulnerability and fragility (Mach, 2019), eventually spurring the surge of violence and conflict (Busby, 2018). However, the ways in which climate change influences security are inherently context-specific. Moreover, certain factors such as **gender**, **age**, **ethnicity** and **socio-economic** status also play an important role, often determining how climate change impacts threaten security in a given context (Detges & Foong, 2023). For example, who migrates and who stays behind when climate change affects livelihoods is clearly influenced by these factors.

In light of these mediating factors, researchers often talk about **pathways of climate-related insecurity**, which facilitates better consideration of what happens between a cause (climate impact) and an effect (conflict and insecurity) (Detges et al., 2020; Busby, 2018). The next sections will present six of the most common pathways of climate-related security risks, as identified by mainstream research on this subject (Detges et al., 2020).

Competition over natural resources

The impacts of climate change and environmental degradation can give rise to new and exacerbate existing **disputes over natural resources** such as land and water. This risk is particularly salient where climate-induced changes in access to or availability of resources occur in a fragile social and institutional environment without the governance arrangements and social cohesion needed for competition and disputes to be managed peacefully (Engel & Korf, 2005). In such cases, competition can escalate into violence, in par-

ticular in areas with a history of violent conflict or where certain groups are excluded from natural resource management institutions, as well as where populations directly depend on natural resources for their livelihoods (Rüttinger et al., 2014). A frequently cited example of these dynamics is farmer-herder conflicts, mostly prevalent in the Sahel region and in some parts of Eastern Africa (Eberle et al., 2020). In Kenya's Tana River Delta, for instance, Pokomo farmers and Orma herders have long been clashing over competing claims to water and land use and property rights, especially after the introduction of privatization policies that did not account for the need for herding corridors (adelphi, n.d.d.). Farmer-herder violence is often also associated with increased rates of gender-based violence, creating a vicious cycle of increasing climate insecurity, conflict and inequality. In Mali, heightened marital tensions, domestic violence, as well as early and forced marriage, sexual exploitation, harassment, rape and limitations on women's rights have been associated with periods of livelihood difficulties linked to climate change and conflict (Nagarajan et al., 2022).

Furthermore, climate change impacts can affect the **governance and management of shared natural resources**, leading to tensions between governments and communities. For example, in many transboundary river basins, there is an increase in water demand due to economic development and population growth, but at the same time a decrease in supply due to the impacts of climate change. This can spur diplomatic tensions and conflict (Blumstein et al., 2016), as currently seen between Egypt and Ethiopia in the context of the Grand Ethiopian Renaissance Dam (GERD).[2]

Livelihood insecurity

Farming, livestock herding and fishing – important livelihoods for many – heavily depend on the availability and stable supply of natural resources. In many places, the impacts of climate change and environmental degradation

[2] Ethiopia has built the GERD upstream on the Blue Nile, which is one of the main tributaries of the Nile, leaving Egypt concerned about potential consequences for its water needs, particularly for irrigation. Egypt's growing water scarcity means it is particularly susceptible to warming temperatures, shifting rain patterns and sea-water intrusion. Due to these uncertainties, there have been ongoing tensions between these two countries, with Egypt at times using strong language and threatening military action. (Source: adelphi, n.d.b.)

will make these livelihoods less reliable or even unviable. A key way through which the linkages between climate change impacts on livelihoods and insecurity manifest is through migration – as people choose or are forced to move from their homes to find a better life for themselves and their families elsewhere.

Of course, migration itself is not inherently a risk and often serves as a coping strategy and an important driver of economic development. However, if movements and integration are not well managed, it can create new challenges in receiving areas and give room for grievances between arriving and receiving communities to arise. This is especially the case for rural to urban migration, as cities tend to be the largest receivers of migrants. In Haiti, for example, youth involved in farming, pastoralism or fisheries in rural areas have migrated to cities, often ending up living in slums without access to basic services and with even fewer economic opportunities. This has been a key factor in the growth of armed gangs, especially in the capital Port-au-Prince, which today pose immense security challenges to the country and its people.[3]

Gender and age are important determinants when it comes to the linkages between climate, migration and insecurity. In Central Asia, for example, migration is a predominantly male phenomenon.[4] This can create stress for women, as they may see an increase in their unpaid workload and hence face additional economic hardships, while their vulnerability to climate and environmental impacts persists (Mosello et al., 2021). Instead, in Bangladesh, women are slightly more likely than men to migrate to cities to work in the garment industry or abroad to be engaged in domestic work (Mosello et al., 2021). This puts them at increased risk of gender-based violence and in some cases even trafficking (Chandran, 2016).

[3] Based on research conducted in the context of an upcoming introductory study on climate and security in Haiti. More information: https://adelphi.de/en/projects/introductory-study-on-climate-and-security-in-haiti.

[4] However, this differs slightly between countries; for example, female migration tends to be more widespread in Kyrgyzstan than in Tajikistan and Uzbekistan. (Source: Rocheva & Varshaver, 2018)

Food price fluctuations and food insecurity

Food production is highly susceptible to changes in climate and the environment. Climate impacts on food production, in turn, contribute to volatility and shocks to food prices and food supply, which can act as a catalyst for protests and political instability in many parts of the world. Between 2008 and 2011, for example, severe droughts hit several of the world's breadbasket regions like the US, Russian Federation and Australia, severely impairing global wheat production. The resulting food shortages and increase in food prices caused social unrest, especially in those countries with high dependence on wheat imports, such as Egypt (adelphi, n.d.c.), eventually affecting the whole region and turning into the revolutions known today as the Arab Spring (adelphi, n.d.e.). Today, these dependencies are being tested once again through the shocks on wheat supply stemming from on-and-off deals in the context of the Black Sea Grain Initiative, in which the Russian Federation has agreed to let Ukrainian vessels resume grain and fertilizer exports via the Black Sea despite the ongoing conflict in the region (UN, 2023a).

Because responsibility for providing and preparing food within households often falls on women, they are disproportionately affected by food price spikes, carrying a higher burden in situations of food insecurity. This is linked to unfavourable structural factors, such as a modern shift away from traditional crops (more often produced by women) towards cash crops and monocultures (usually produced by men), which also has a negative impact on nutrition. In fact, when looking at the four dimensions of food security – availability, access, utilization and stability – women are more susceptible to food insecurity and malnutrition than men in every region of the world (Botreau & Cohen, 2019).

War, crime and conflict financing

When climate and environmental changes make livelihoods unviable, the need for survival can push people to turn to illegal or unsustainable activities – a phenomenon that is usually referred to as maladaptation (Schipper, 2020). In Afghanistan, for example, many farmers have turned to illegal poppy seed cultivation, which is used for opium production and trade by traffickers and armed groups. In part, this shift has been driven by climate change undermining traditional crop farming, while poppy is a more drought-resistant crop (Brown, 2019). Similarly, in Somalia, some pastoralist groups have

turned to wood-cutting for illegal charcoal production, thus contributing to large-scale deforestation and impairing the livelihoods of rural farming communities who depend on forests (adelphi, n.d.a.). More generally, environmental crimes, such as illegal logging and drug production, are often at the centre of conflict economies, representing about 38% of the financing for armed and terrorist groups (Nellemann et al., 2018). The high profit potential of environmental crimes provides incentives for such actors to prolong and expand conflict, while conflicts involving natural resources have a higher probability of reigniting after resolution in comparison to other conflict types (Nellemann et al., 2014).

At the same time, wars and conflicts can lead to environmental destruction and contribute to climate change. The areas in and around conflict hotspots are often filled with wreckage from bombed infrastructure and damaged military equipment, chemical pollution and, at times, even radioactive waste. In Syria, 12 years of war have brought severe damage to the country's orchards and cleared 36% of its forested areas. This happens both directly (due to fighting) and indirectly (due to the war's impacts on livelihoods, which create incentives for maladaptation practices) (Najim et al., 2023). Because of the heavy reliance of militaries on fossil fuels, they are also serious emitters of greenhouse gases; it is estimated that they are responsible for 5.5% of global emissions (Cottrell & Parkinson, 2022).

Extreme weather events

Extreme weather events are natural occurrences. However, climate change is making them more frequent and more severe (IPCC, 2023). Rapidly changing weather patterns are increasingly difficult to predict and, therefore, to prepare for. When an extreme weather event hits a country, it is common that some level of insecurity is present in the aftermath. For example, as institutions are overloaded with response and recovery measures, they might be less able to provide public security and crimes may spike (Peng & Zhan, 2022; Corcoran & Zahnow, 2022). Yet, such effects are normally temporary, as states are usually able to restore order eventually. But when disasters happen in succession and the government is not able to adequately respond to them, or when some groups perceive themselves as being excluded from the responses, that can feed back into existing grievances and political instability and have the potential to undermine the legitimacy of the government (Harris et al., 2013).

In 2011, for example, Thailand was hit by severe floods that affected almost two million people. This happened during an already fragile political situation: regular protests against the government had been happening since 2008 and at the time of the floods, there was a brand-new government in power. In the aftermath of the floods, the response and aid provided by the new government was perceived as not transparent and unfair, amplifying these grievances and leading to the outbreak of a new wave of protests that continued until the coup in 2014 (adelphi, n.d.g). Yet, the opposite is also true: in 2004, when Indonesia's northern Sumatra region was hit by the Indian Ocean tsunami that killed more than 167,000 people and displaced over 500,000 people, the Indonesian president proactively used peacebuilding as part of response efforts. The country had been in civil conflict since the 1970s and, after the tsunami, the president called upon the population to unite for reconstruction. This culminated in a peace agreement between the parties and a subsequent ceasefire that lasts until today (adelphi, n.d.f.).

Unintended consequences of climate and security policies

Responses to climate and environmental impacts or to insecurity and conflict carry their own risks. For example, about ten years ago, several countries introduced quotas for biofuels to reduce greenhouse gas emissions. However, these fuels are often produced through large-scale monocultures, such as palm oil and sugar cane. Besides the negative environmental and climatic impacts of such agricultural models, in many contexts this has provided actors with financial incentives to forcefully grab land from local communities, creating new conflicts and spreading insecurity (Balehegn, 2015; Selfa et al., 2015).

Equally, humanitarian and peacebuilding efforts can unintentionally foster climate change and environmental degradation, and even exacerbate insecurity and conflict dynamics. In the Lake Chad Basin, home of one of the world's largest humanitarian emergencies with up to 6.9 million people in need of assistance as of 2023 (OCHA, 2023), it was observed that people in camps for displaced persons were receiving supplies of food, but no cooking fuel to prepare them. This led people to leave the camps and move to areas controlled by armed groups in order to have access to wood fuel, putting their security at risk. Those who stayed in the camps started cutting down forests in the surrounding areas, laying the ground for even more climate risks in the future (Vivekananda et al., 2019).

Siloed military and security strategies can also undermine livelihoods or coping strategies, paradoxically leading to insecurity on other fronts. Such strategies often include restricting movements of people, which can impede local communities in accessing certain areas that are key for fishing, farming and cattle rearing, as well as for commercializing their produce. The same goes for peacebuilding: in Colombia, after the peace accord between the state and the Revolutionary Armed Forces of Colombia (FARC) was signed in 2016, ending over 50 years of armed conflict, the militia was demobilized and left the forest areas they had occupied for decades. In the aftermath, other groups moved into these areas and deforestation increased by 400%. Violence against environmental defenders has also skyrocketed ever since, with Colombia now being one of the world's most dangerous countries for them, as well as leaders of indigenous communities (FIP & adelphi, 2021).

Another poignant example of the failure of isolationist policy is critical mineral mining. Many countries in the Global South are home to vast quantities of minerals such as cobalt, lithium, and other earth elements that are vital to build batteries and renewable energy infrastructure. To acquire the resources crucial for a green energy transition, wealthy, industrialized states have centred their policies around securing these minerals with little consideration for the impacts of the trade on local populations. In the Democratic Republic of Congo (DRC), for example, the cobalt trade has fuelled violent conflict, human rights abuse and insecurity, causing up to 2,000 deaths annually (Amnesty International, 2015; Arvidsson et al., 2022). Yet, the effects of cobalt mining on the labourers and surrounding communities have been missing from the foreign policy discussion, with critical consequences for peace and security (Church & Crawford, 2020; Business & Human Rights Resource Centre, 2020).

Institutional responses to climate security challenges

The increasing manifestation of climate-related security risks in many contexts worldwide, and especially in those already characterized by fragility and conflict, has prompted institutional responses across the policy landscape. Policymakers have become less likely to consider climate change an isolated problem, acknowledging the need for horizontal and vertical collaboration to address the interdependent challenges it poses (Climate Diplomacy, 2022). Key climate change topics, such as adaptation and mitigation, are increasingly discussed alongside security objectives, with interventions more likely to

consider climate change impacts within stabilization, peacebuilding and development efforts.[5] Now, research institutions and governments alike assert that climate policy should not only be part of foreign policy; rather, foreign policy *is* climate policy (G7 Foreign Ministers, 2022; Wilson Center 2020).

These policy and programming developments emerged partly from shifting academic paradigms, which have broadened the scope of climate analysis beyond environmental impacts, emphasizing the wide-reaching effects of climate change across a diffuse group of sectors.[6] However, increasing policy integration can also be attributed to the institutional experience gained as the climate-related security field evolved. With more programming being piloted, policymakers and practitioners are seeing increasing evidence that responses attempting to approach climate-related security challenges within a single sector are less effective, in extreme cases exacerbating conflict dynamics (Detges et al., 2020; Seyuba & Meijer, 2023). Even in moderate cases, siloed approaches to climate-related security challenges have not been as successful as multilateral ones (adelphi, 2022). On the contrary, effective responses have proven to be those cutting across sectors and policy areas and acknowledging the inherently complex and multi-dimensional character of climate-related security risks (Detges et al., 2020). While demands for comprehensive and integrated action increase, certain sectors are prioritized in the discourse. Cross-cutting responses in climate, disaster risk reduction, development, humanitarian, stabilization and peacebuilding efforts are believed to be particularly in need of multi-dimensional approaches (Mosello et al., 2020).

The following sections outline some of the efforts that have been made by international organizations and civil society to integrate climate-related security considerations into their programming.

OSCE

The OSCE works according to principles of international cooperation and democracy promotion to achieve its goals. It was one of the first multilateral players to recognize the linkage between the environment and security and to acknowledge climate change as a long-term challenge in its 2007 OSCE

[5] For example, livelihood loss due to desertification, migration due to flooding, etc. (See: Ide et al., 2021)

[6] For an overview of the development of the climate security field in academia. (See: Von Uexkull & Buhaug, 2021)

Madrid Declaration on Environment and Security (OSCE, 2007). More recently, in 2021, the OSCE released a Ministerial Decision on climate change action and cooperation, in which it acknowledged that climate change policy can serve as an opportunity for collaboration between states, "building mutual confidence and promoting good neighborly relations." (OSCE, 2021b, p.2) The Ministerial Decision also called upon members to integrate climate considerations into national policy, take a multi-stakeholder approach by engaging academia, the private sector, civil society, etc., and to use the OSCE as a platform for facilitating exchange on climate change adaptation and mitigation (OSCE, 2021a).

Under this umbrella, the OSCE funds a range of activities to address climate resilience, adaptation and mitigation for peace and security, typically confining its efforts to the internal development of OSCE participating States (Barnhoorn, 2023). Many of these activities revolve around a comprehensive understanding of security, with the logic that climate change threatens economic prosperity, institutions and stability. Some of the OSCE's most recent activities in this field have included livelihood support, cultural heritage support, and sustainable tourism promotion in the framework of its flagship project, Strengthening Responses to Security Risks from Climate Change in South-Eastern Europe, Eastern Europe, the South Caucasus and Central Asia.[7]

United Nations

The United Nations (UN) has undertaken significant efforts to absorb climate and security considerations into its policies and develop the necessary structures to address the related challenges. Since the first UN Security Council (UNSC) debate on the impact of climate change on peace and security in 2007, the UN has issued a long list of statements and resolutions on climate-related security risks (UN, 2007). These have mostly focused on specific countries and regions deemed most vulnerable, including the Lake Chad

[7] The project is being implemented by the OSCE in partnership with adelphi. It aims to reduce climate change-related security risks through raising awareness, developing capacities and sharing knowledge regarding the implementation of climate change adaptation measures. (See: OSCE, n.d.)

Basin, Somalia, Mali, and Darfur, among others.[8] Comprehensive and ambitious action, however, has been compromised by a lack of geopolitical collaboration.[9] In the absence of UNSC consensus, "speech acts" by UN and other leaders have attempted to advance climate and security principles in the policy domain with constructivist methods, drawing attention to – and thus shaping – the climate-related security agenda (Odeyemi, 2020). For example, Secretary-General António Guterres' New Agenda for Peace policy brief, published in July 2023, highlighted the risks that climate change poses to international peace, calling to systematically address the peace and security implications of climate change in peace mandates as well as in regional operations (UN, 2023b).

Meanwhile, significant efforts in terms of integrated climate, peace and security action have been taken across UN agencies. In 2018, the Department of Peacebuilding and Political Affairs (DPPA), the Department of Peace Operations (DPO), the United Nations Environment Programme (UNEP), and the United Nations Development Programme (UNDP) established the Climate Security Mechanism (CSM) to address climate-related security challenges "more systemically." (UNEP, 2020) To date, the CSM has provided multidisciplinary support to Member States, regional organizations and United Nations entities, including field missions and UN Resident Coordinators, and has undertaken a range of activities to address relevant challenges, including conducting climate security risk assessments and developing risk management strategies (UNEP, 2020). The Secretary-General's Peacebuilding Fund (PBF) has also shown particularly extensive engagement with climate and security programming, investing in more than 70 climate-informed peacebuilding projects implemented by 21 different entities since

[8] So-called "thematic" resolutions.

[9] Permanent and non-permanent members of the UNSC have divergent views on the extent to which climate change should be integrated into the global peace and security agenda, with China and Russia being notable opponents on the ground that climate change is essentially an issue of sustainable development, and hence not part of the UNSC's remits. In December 2021, it was a Russian veto that caused a resolution defining climate change as a "threat to international peace and security" to fail. Meanwhile, other states, including wealthy nations such as the United States, but also smaller states that are highly vulnerable to climate change impacts, see climate change as an "existential threat," thus justifying its place on the UNSC's agenda. (See: Security Council Report, 2023)

2017. These projects have been key to push boundaries and galvanize greater attention to the nexus between climate, security and peacebuilding, piloting innovative approaches towards the 'bottom-up' realization of global commitments to encourage community adaptation (Gaston et al., 2023).

European Union

The European Union was one of the first regional organizations to adopt the climate and security doctrine, arguing as early as 2008 that the "threat multiplier" nature of climate change requires it to be at the heart of EU security policy (European Commission, 2008). Since then, the EU has undertaken a range of activities on climate security. These have included granting climate aid to low- and medium-income states, incorporating climate change considerations in its development and peacebuilding activities, looking at climate change from a migration management perspective, and advancing the EU's economic interests in climate action at the international level (Bøås, 2020; European Parliament, 2022; Young, 2021). However, until recently, the EU has largely limited its attention and funding to the end of the causal impact chain, by supporting livelihoods, good governance and peacebuilding efforts in the Global South, while confining the causes of such risks, which include EU emissions, to other policy spheres (Michel, 2021).

More recently, however, in 2023, the EU published a Joint Communication laying out how it will address the growing impact of climate change and environmental degradation in the fields of peace, security and defence. This was a critical step, setting an EU-wide framework for responding to these challenges, consisting of a set of concrete actions across the entire spectrum of data, policies, missions, defence, and cooperation with third parties to ensure that the impacts are accounted for in all levels of external policymaking, planning and operations (European Commission, 2023).

African Union

In contrast to the EU, the African Union's climate and security agenda has been broadly domestically focused, designed with the recognition that its Member States are among the most exposed to climate-related security risks globally (Notre Dame Global Adaptation Initiative, n.d.). The dual concerns of climate change and conflict and demonstrable overlap between the two in

many African countries have given the AU first-hand experience on climate-related security problems. Due to this, the AU has increasingly become the flag bearer of climate and security action on the international stage (Kodio, 2021). In 2022, the AU released a ten-year climate action plan outlining the potential impacts of climate change on food, migration and conflict, noting that "climate change may contribute to an increase in the frequency and intensity of conflict and human security issues on the continent, creating protracted and multifaceted humanitarian and security crises that will strain the capacity of the African Union Peace and Security Architecture (AUPSA) and other peace and security mechanisms to effectively respond." (African Union, 2022b, p.14).

In terms of foreign policy, the African Union has used the international stage to highlight the disproportionate role Global North countries have played in causing the climate crisis, pushing for compensation through loss and damage and climate adaptation funding at the Conference of the Parties (COPs) and other summits (African Union, 2022a).

NATO

Being first and foremost a military alliance, NATO is distinct from the previously outlined international organizations that view security as just one among many components of their mandates (Barnhoorn, 2023). NATO's approach to climate change is instead framed within a more traditional security context that is concerned with great power rivalry and the protection of Western interests (NATO 2023b). Early climate change considerations in NATO were centred on discussions of how its operations were impacting the environment and climate change through emissions. As the debate on climate and security began to evolve at the institutional level, however, discourse within NATO bodies also shifted towards focusing on how the effects of climate change could impact NATO operations (Barnhoorn, 2023).

In recent years, both dimensions have been integrated into NATO's portfolio, disrupting previous theoretical security paradigms that framed climate and security spheres dichotomously, with climate considerations thought to weaken or disrupt security operations (Shea, 2022). The war in Ukraine and the COVID-19 pandemic were instrumental in this conceptual pivot, demonstrating the "interlinkages between conflict, environmental degrada-

tion, and societal instability, and how these can lead to greater security risks for NATO." (NATO, 2022) NATO's 2022 strategic concept, for example, recognized climate change as a "defining challenge of our time," stating that NATO should be the "leading international organization when it comes to understanding and adapting to the impact of climate change on security." (NATO, 2022, p.11) At the NATO Vilnius Summit of July 2023, NATO Member States committed to continuing to address the impact of climate change on defence and security, integrate climate change considerations into all of NATO's core tasks, and contribute to the mitigation of climate change by significantly cutting greenhouse gas emissions (NATO, 2023a).

Civil society

Civil society has traditionally been at the forefront of concrete and direct action to address climate-related security risks. Especially as governments and international organizations have started embracing the climate security agenda, growing funding allocations have followed, enabling more action at the civil society level. NGOs engaged in peacebuilding have increasingly built and included climatic considerations, programs, and teams into their work. Mercy Corps, for example, has been particularly influential in this regard, using climate change adaptation interventions as an entry-point for peacebuilding in its work in the Horn of Africa since 2019 (Mosello & Rüttinger, 2020; USAID, 2020). In Colombia, local NGOs have been actively engaged in environmental peacebuilding projects for decades, working on land access, advocating against deforestation, and supporting local self-governance of resources (Hachmann et al., 2023; Gonzales, 2021).

However, while climate-related security risks have been integrated into development and peace programming, environmental and climate change NGOs have been less likely to integrate security considerations, perhaps due to funding challenges. But this, too, is starting to change. The WWF, for example, has produced joint research with adelphi on the links between the environment, security and peace and called for wider incorporation of environmental dynamics into the climate security portfolio (Rüttinger et al., 2022).

Conclusion

While efforts to better understand and address climate-related security risks are substantial and growing, as outlined in this chapter, more remains to be done for the field to develop, particularly in terms of policy and programming (USAID, 2020). Structural barriers characterize the current institutional landscape, with both funding and implementing organizations not set up to address problems using cross-sectoral expertise and methods. Those attempting to formulate responses to complex and multi-dimensional climate-related security challenges face several key obstacles.

Firstly, the climate-related security field is still nascent. While many of the ways in which climate change and insecurity are linked are becoming increasingly visible and difficult to ignore in many contexts around the world, more research on context-specific climate-related security challenges and how they affect different people and groups differently based on pre-existing socio-economic dynamics is needed. More disaggregated, targeted monitoring and evaluation efforts are also crucial to understand what approaches have worked to address these challenges. Measuring impact is invariably a major challenge in security programming, where conflict prevention and mitigation is difficult to prove. Climate-related security evaluation faces even further barriers compared to traditional security analysis, as not enough funding is available.

Secondly, climate-related security discourses and rhetoric have not yet translated into concrete policy and funding commitments, particularly at the highest levels. This has inhibited the ability of governments and civil society to commit to the cross-sectoral and long-term programs and projects that would instead be required to address risks, especially for the most vulnerable and marginalized people. Climate-related security risks often lie between or beyond the scope of different bodies and agencies, inhibiting multilateral collaboration. This also means that funding remains siloed. Meanwhile, conflict zones are largely excluded from development funding, including climate finance – sequestering aid from those who need it most (UNDP, 2021; Cao et al., 2021).

Finally, despite ambitious claims, the discourse around climate-related security risks has not yet been successful in re-imagining the security establishment. The field remains steered by wealthy nations who operate according

to long-defined principles of national and international security. Those affected most by climate change, conflict, and international intervention face prohibitive hurdles that exclude them from discourse, policy design, and program evaluation. Moreover, the leading role that Global North countries have taken in climate security integration has offered them an opportunity to organize the climate and security agenda according to their priorities (Sultana, 2022; Warner & Boas, 2019; Kedia et al., 2020). As a result, many regions, despite being highly vulnerable to climate-related security risks, are not given proportionate attention, for example Latin America and the Caribbean. These dynamics pose challenges for climate security beyond operational matters, forcing the question of what security means in the context of climate change, and for whom. In a security environment pervaded by zero-sum equations, such questions will not be easy for climate-related security to resolve.

These complications aside, it is beyond doubt that the progress of the climate-related security field in recent years has been trail-blazing. The integration of climate change into the security field has opened up new ways of understanding security, forcing some of the most rigid, hierarchical organizations globally to re-evaluate their methods and consider flexible, collaborative responses to conflict. It has also forced the security sector to consider how it is contributing to the climate crisis, locating all actors within a system that they have the potential to change for the positive. Despite both theoretical and operational problems that still need to be solved, this emerging field offers rich opportunities for critical engagement and creative programming to tackle some of the most demanding challenges humanity has yet faced.

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The OSCE and Military Emissions: Next Steps and Mitigation of Greenhouse Gases

Linsey Cottrell, Duraid Jalili, David Burbridge

Climate change threatens ecosystems and the health and livelihoods of humans around the globe. To limit the increase in global temperature to 1.5 degrees Celsius and reduce greenhouse gas emissions, major transitions are required across all sectors, including the military. Armed forces are facing increased pressure to make progress on mitigating their emissions, and doing so requires transparency and collaboration to ensure an effective climate mitigation policy on the part of the military.

Current status

Ten years ago, the Intergovernmental Panel on Climate Change released its globally peer-reviewed Fifth Assessment Report (IPCC, 2013), which concluded that climate change is unequivocal, and human activities – chiefly the release of polluting greenhouse gases from burning fossil fuels (coal, oil, gas) – the main cause. Yet, international climate action has been slow, and efforts remain insufficient to prevent the global temperature from rising more than 1.5 degrees Celsius by the next century (UNFCCC, 2022). The IPPC's 2021 Sixth Assessment Report (AR6 report) warned that changes to the climate are unprecedented and that there is no more time to be wasted (IPCC, 2021). The outcome from COP28 climate conference was historic, with States agreeing to transition away from fossil fuels and towards renewables (Carbon Brief, 2023), but drastic reductions in greenhouse gas emissions are needed. The World Meteorological Organisation confirmed that 2023 was the hottest year on record (see Figure 1, WMO 2024) and there are concerns that the IPPC has 'underestimated climate sensitivity and understated the threat of large sea level rise and shutdown of ocean overturning circulations' (Hansen, 2023).

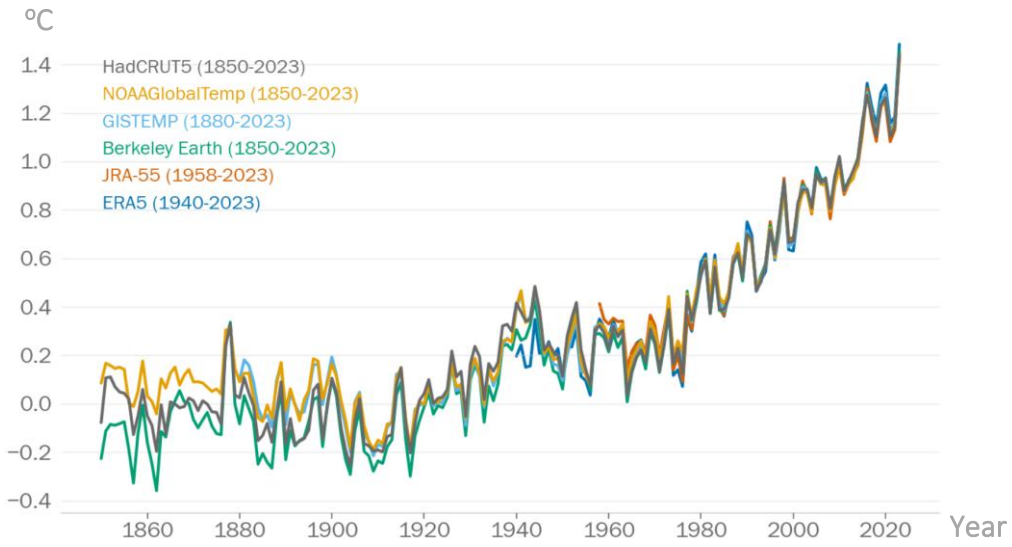
Until recently, armed forces around the world have been largely exempted from national or trans-global discussions to mitigate climate change by reducing their greenhouse gas (GHG) emissions. While almost every country in the world has set GHG reduction targets (Umemiya, 2023), few have committed to include their military forces.

The military is a huge consumer of fossil fuels, with large and complex supply chains. Analyses of fuel procurement data between 1998 and 2018 indicated that the United States' military was the single largest institutional consumer of fossil fuels in the world (Crawford, 2019). The total greenhouse gas emissions across all military forces remains unclear, although estimates have been made.

In June 2023, the NATO Secretary General reiterated the need "*to reduce the quite substantial emissions from military activities*" (NATO, 2023e, para.6), and the second annual Climate Impact Assessment includes the requirement to reduce the NATO enterprise's GHG emissions (NATO, 2023b). As set out below, in order to do so it is important to better understand the significance of military GHG emissions, the mitigation measures that can be taken, the challenges in addressing this, and the relevance to OSCE participating States (pS).

Critically, what can the OSCE do to support this transition and how can the OSCE promote greater cooperation between participating States in tackling the military contribution to climate change?

Figure 1 – Changes in global mean temperatures compared to 1850-1900 average
(Reproduced figure from the World Meteorological Organization, 12 January 2024)



Greenhouse gases and the military: the 'dual obligation'

Some people refer to the impact of climate change upon armed forces as a 'dual obligation'. On the one hand, armed forces must respond and adapt to a larger and more diverse set of demands, from the prospect of warfighting in climate-exacerbated conflicts to non-warfighting roles, such as humanitarian assistance, disaster relief and border control, and climate-related emergencies. The role of the military in providing climate-related emergency relief and preparedness planning is controversial (Bollen & Kalkman, 2022) and marked by varying views, according to the country and the respective political context, and accusations of 'military mission creep'. This obligation to adapt leads to increased incentives and pressure to expand operational capabilities. On the other hand, armed forces face increasing political and public pressure to reduce their own climate and environmental impact and avoid creating the very effects that catalyse insecurity.

This second obligation is significant in both scale and urgency. It is estimated, for example, that the activities of military forces worldwide (including the industrial production of military capabilities but not warfighting activities themselves) account for approximately 5.5% of all global GHG emissions (Parkinson & Cottrell, 2022). Indeed, research suggests that there may even exist a two-way link between military expenditures and GHG emissions (Bildirici, 2018), and that militarisation itself can drive production and consumption patterns of wider national economies towards more carbon-intensive systems (Jorgenson et al., 2023). In addition to this, the act of conflict itself causes significantly damaging environmental impacts that can lead to a vicious cycle of conflict and loss (Weir, 2020).

Military forces belonging to OSCE pS represent a particularly large share of this overall total. The US Department of Defence alone, for example, is the largest institutional producer of GHGs – of any kind or sector – in the world, with annual emissions (from installations and operations) akin to the national GHG emissions of an entire country, such as Portugal (Crawford, 2019). Although the US represents a disproportionately large share of these outputs, other OSCE pS are not exempt. The official annual GHG emissions for 2022-2023 of the UK Ministry of Defence, for example, are given as 3.1 million tons of carbon dioxide equivalent (CO_2e) (UK MOD, 2022), which

is similar to the emissions of about 1.7 million average cars.[1] These official statistics, however, under-report the true picture, since other indirect emissions are not included. An inquiry report by the UK House of Commons Defence Committee noted that 'understanding and reporting total emissions will be essential' and that 'Defence can do much more to measure and reduce its carbon emissions – without eroding the military capacity' (2023, p.3).

Only broad estimates on the overall contribution of the military to global greenhouse gas emissions are possible, with limited attention or research done by just a few academics to date. Data on military fuel use submitted to the United Nations Framework Convention on Climate Change (UNFCCC) is incomplete[2] and, given the huge gaps, not useful for estimating total military emissions. The problem with data gaps in reporting extends beyond the military, but as global military spending increased to around US$ 2.24 trillion (Stockholm International Peace Research Institute [SIPRI], 2023) in 2022, concerted action is needed to better report military emissions and take measures to reduce the related carbon footprint – especially as these emissions are very likely to increase in line with military expenditures.

The methodology used to provide the 5.5% global estimate (Parkinson & Cottrell, 2022) relies on assumptions about variations between military structures across regions. This includes estimates on the number of military personnel, the carbon intensity of their economies, and the likely ratio of stationary GHG emissions (i.e. from military assets and bases) compared to mobile military activities (such as the use of aircraft, navy vessels, land vehicles and spacecraft). Emissions from mobile activities depend on several factors, including the quantity, age, specification and utilisation of equipment, which highlights the difficulty and limitation of the assumptions made. The 5.5% estimate does not even include emissions caused by warfighting itself or the additional non-carbon dioxide heating effect from aircraft flying at high altitudes, and the effects of aviation contrails.[3]

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1 Based on the assumption that an average car emits approximately 1.8 metric tonnes of CO_2e each year.

2 See https://militaryemissions.org/.

3 Water vapour, contrails and non-CO_2 effects are recognised as a significant contribution to the effects of aviation on climate change but are not widely taken into account.

As will be discussed later, there are significant barriers preventing a clear picture of military emissions. This scenario also creates a wide range of known and unknown risks and opportunities for military forces and their governments. These risks and opportunities, which are critical for the OSCE remit, include:

- **Conflict prevention and resource management.** As a contributor to global GHG emissions, the military function ranks among those factors that threaten life, health and wellbeing, habitability, income, food security and infrastructure, as well as cause land loss and migration (IPCC, 2022). These risks are further exacerbated in areas where resource extraction for use in military capabilities generates pollution, habitat destruction and armed force (Downey et al., 2010). This presents the OSCE pS with the opportunity to reduce potential drivers of conflict by enhancing efficiency, sustainability and circularity across the value chains of its military forces, and capacity building in areas where resource extraction occurs as a result of military requirements.
- **Energy security.** The fossil fuel requirement of OSCE pS armed forces have generated a scenario in which national security is not only ensured at the cost of socio-economic harms (Healy et al., 2019), but is also becoming increasingly vulnerable to supply disruptions and price fluctuations (Samaras et al., 2019). Harnessing the collective influence and buying power of OSCE pS armed forces to drive sustainable energy innovation could not only enhance energy independence and security, but also help catalyse positive tipping points for socio-technological advances (e.g. price reductions in renewable technologies, wider societal behavioural shifts, etc.) (Fesenfeld et al., 2022; Motta et al., 2021)
- **Operational effectiveness.** Climate change poses direct risks to the operational effectiveness of military forces as it creates environmental conditions, which are beyond the operating capacity of military platforms and personnel, and also stretches military resources as the military is increasingly called upon to support non-traditional roles (e.g. humanitarian and disaster relief, border control, epidemic response, etc.) (Cox et al., 2021). Enhancing sustainability is often

viewed from a military perspective as reducing the drivers of such risks, while providing forces with significant logistical advantages (e.g. on-site power, water and food production and more self-sustaining systems would reduce high-risk and high-cost resupply missions) (UK Strategic Command Defence Support, 2022; Samaras et al., 2019). It is also suggested that tying such capabilities to local adaptation initiatives can also serve as a force multiplier for other local adaptation initiatives (Teicher, 2019).

- **Financial and legal risks.** The legal framework on the Protection of the Environment in Relation to Armed Conflict (PERAC) was adopted in 2022 and sets out how the environment should be protected before, during and after armed conflicts as well as in situations of occupation (UN General Assembly, 2022). The twenty-seven PERAC principles vary from non-binding guidance to reflecting binding international law, including recognition of the potential to exacerbate global environmental challenges, such as climate change and biodiversity loss. As such, national military forces face an increased obligation to comply with international and national environmental agreements and regulations, although exemptions or derogations are often applied. Furthermore, the Aarhus Convention also makes it possible to refuse giving environmental information if this adversely affects national defence or public security (UN Economic Commission for Europe, 1998). Military forces, however, may face legal challenges and accusations based on 'environmental negligence' and even 'ecocide' in theatres in which such laws may be enacted prior to, during or following a conflict.[4] This includes costs associated with responding to environmental damage through wartime and peacetime emissions (from humanitarian relief to pollution clean-up), but risks also significantly strain the national budgets of OSCE pS (Weir, 2020).

[4] There are calls to amend the Rome Statute of the International Criminal Court to include ecocide. For a proposed consensus definition of 'ecocide', see https://www.stopecocide.earth/legal-definition.

- **Reputation and diplomacy.** All the issues highlighted above create significant reputational risks for the armed forces of nation-states and the nations they represent (exacerbated by information operations by adversary groups) (Bellasio et al., 2023). This, in turn, may undermine diplomatic efforts, hamper collaboration, and erode trust between local populations and the military. Active and transparent efforts to reduce the environmental impact of the military represents an opportunity to enhance the reputation and performance of OSCE pS. Tangible gains in the sustainability policy and innovation may also provide a valuable subject for inter- and intra-state diplomacy and collaboration and is likely to be of increasing importance in future climate-exacerbated security scenarios (Bellasio et al., 2023).

As this section highlights, and although these areas might involve significant risks, they could equally be seen to provide an opportunity for leadership on the part of the OSCE and its participating States. These contexts highlight three clear areas for the OSCE to demonstrate leadership in the area of military emissions; namely: i) collaboration on military GHG mitigation policy; ii) transparency in reporting; and iii) collaboration on implementing mitigation action.

Collaborating on military GHG mitigation policy

The OSCE's comprehensive approach to security incorporates politico-military, economic, environmental and human dimensions, and affirms that "*military security and stability can be achieved through greater military transparency, openness and exchange of military information*." (OSCE, n.d.d, par.1) Environmental matters have always been an intrinsic component of the OSCE's agenda. The 1975 *Helsinki Final Act*, which founded the OSCE's forerunner organisation, recognised the importance of environmental protection for peace and security, and underlined the relevance of close international collaboration in this regard (OSCE, 1975).

To the same extent as the understanding of the science and impacts of climate change have progressed, also the recognition of the interconnected strategic risks across social, economic and environmental dimensions has increased. Consequently, climate change is seen to hold critical implications for national security, although divergent perspectives remain between some

nations on the magnitude of climate change impacts and their prioritisation of climate action. There is a general global trend of growing political attention paid to climate security, as addressed at the OSCE High-Level Conference on Climate Change in July 2023 (OSCE, 2023).

The complexity and interdependent nature of climate change makes the topic fit naturally into the OSCE's comprehensive approach. The 2003 *Strategy Document for the Economic and Environmental Dimension* includes the concepts of sustainable development and "environmentally friendly energy supply" (OSCE 2003, p.5), as well as encouragement to participating States for "further development and use of new and renewable sources of energy" (OSCE 2003, p.5) and the ratification of the Kyoto Protocol (OSCE, 2003). The 2007 *Madrid Ministerial Declaration on Environment and Security* specifically acknowledged climate change and its potential to amplify environmental factors leading to conflict, as well as recognised climate change as a long-term challenge (OSCE, 2007). Furthermore, the OSCE has collaborated in projects to enhance transboundary and regional cooperation in the Southern Caucasus, Eastern Europe, South-Eastern Europe, and Central Asia (OSCE, n.d.b; OSCE, n.d.f).

In December 2021 (OSCE, 2021a), the OSCE's Ministerial Council Decision No. 3/21 (MCD 3/21), *Strengthening Co-operation to Address the Challenges Caused by Climate Change,* was issued. This document is the result of increasing attention being paid to climate change on the part of OSCE pS and was prioritised by the then OSCE Chairperson-in-Office that hailed the agreement as "truly ground-breaking" (Linde in OSCE, 2021b, par.2) and underlined that it demonstrates that "the world's largest regional security organization…has an important part to play in finding, preventing and mitigating measures that can make a difference for the security of the people in the OSCE region. (Linde in OSCE, 2021b, par.2)" Enshrined in the document are aspects such as cooperation in mitigating the negative economic, social, and environmental impacts of climate change, the increased use of clean and renewable energy sources, and the adoption of a multi-stakeholder approach to addressing climate change by engaging the private sector, academia, civil society, and beyond (OSCE, 2021a).

MCD 3/21 put the topic of climate change firmly on the OSCE's agenda, representing the first time that OSCE pS agreed how they would collaborate

in addressing the diverse challenges of climate change (2021a). This agreement was entered into during a period of high military tension in Europe, while Russia was amassing military forces in advance of its February 2022 invasion of Ukraine (Bremberg, 2023), and only a week before Russia vetoed a UNSC resolution that was the culmination of a multi-year effort to "integrate climate-related security risks as a central component into comprehensive conflict-prevention strategies of the United Nations"(United Nations Meetings Coverages and Press Releases, 2021, par.3). This underscored the continuing relevance of the OSCE and its convening power in bringing together 57 participating States from across three continents and by creating consensus on a topic of common interest, but not always common agreement.

Nations and international organisations must not only learn to effectively respond to climate-related impacts, but also accept their responsibility to meaningfully and visibly contribute towards helping mitigate climate change through GHG reductions. Unfortunately, up to the present, military forces have made little progress in reducing their fossil fuel requirements, and typically increase their energy needs over time because of more powerful weapons and communications systems, longer operational reach, infrastructure improvements, and other technologies. The European Parliament's resolution for COP28 cites the need for accelerated decarbonisation in the defence sector, target setting and transparency by its Member States (European Parliament, 2023). Progress in decarbonisation will depend on budgetary resources and operational priorities, and to date few countries have set out climate mitigation strategies for their military (Council of the European Union, 2024). While technology may provide significant battlefield advantages and improve the soldiers' quality of life, the trade-off has been an enormous modern-day energy demands that risks overextension and is often inefficient. As well as environmental impacts, unmanageable military energy demands can lead to unacceptable risks for disruption to operational plans, leaving time and space for adversaries to plan countermeasures and seize the initiative.

A reduction in military carbon-based fuel requirements and the diversification and reduction of energy needs mitigates the operational carbon footprint and enhances military energy security. In the short term, many armed forces have achieved various levels of GHG reductions for assets such as

domestic military installations and with civilian pattern vehicle fleets. Operationally speaking, the military forces of many OSCE pS have succeeded in reducing carbon-based energy dependencies for deployed camps, but emissions from these camps are typically only a very small portion of the total operational emissions and technically much easier to achieve than other more substantial reductions. Meaningful GHG reductions for large platforms, most importantly air assets, will be much more critical and challenging if operational effectiveness must not be compromised in the process.

Within the coming decades, global energy transitions will increasingly affect military organisations. These and other innovations will continue to change our societies, our economies and the structure of our workforces. OSCE pS will have to continuously assess technological developments for their energy implications and adapt accordingly. States will have to be attentive to accelerating innovations for alternative energy sources and their applications. This is especially important for large military equipment procurements that typically require a significant lead-time and whose operational lifecycle lasts several decades. Poor purchases that do not have the potential for adaptation to future energy needs, or for which the full lifecycle and environmental footprint have not been properly considered, must be avoided. Achieving all these objectives will not just be a military concern but require significant support from the civilian sector.

Given the existing partnerships and national overlap across the OSCE, NATO and the EU, there is strong potential for reciprocal exchange of best practice in mitigation action, to foster interoperability and avoid unnecessary overlap in efforts. All three organisations have produced progressive policies, roadmaps or agreed on decisions on how they will deal with challenges related to climate change. MCD 3/21 encourages using the OSCE as a platform for facilitating such exchanges, and the EU's Climate and Defence Roadmap invites Member States to share ideas and best practices (European Union, 2020).NATO elevated the subject of climate change as a key topic within the NATO 2030 process – it received attention within the 2021 (Brussels), 2022 (Madrid) and 2023 (Vilnius) Summit Communiqués, as well as NATO's 2022 Strategic Concept. Furthermore, a *NATO Climate Change and Security Action Plan* has been promulgated, and Canada will be the framework nation for a NATO-accredited Climate Change and Security Centre of Ex-

cellence (CCASCOE) opening in early 2024. All twelve of the CCASCOE's sponsoring nations are also OSCE pS.[5]

NATO has also published a compendium, containing examples on how some NATO members are putting climate change and security plan measures into practice (NATO, 2023a).

As mentioned earlier, armed forces have typically been exempted from national and international GHG reduction discussions as well as meaningful reporting or commitments. This is often framed as military necessity due to the belief that operational effectiveness and security for this component of national power is paramount, beyond responsibility or accountability for their climate change impacts. While armed forces do hold important roles in societies for reasons of deterrence, national defence and the promotion of peace, the scope for armed forces to escape criticism for inadequate climate action within its forces will diminish over time, particularly as governments and private citizens must absorb the increasing costs and physical effects from climate-related extreme weather conditions. Some nations that want only disregard climate action of their military forces could conceivably find themselves unwelcome to participate in multinational exercises or other forms of collaboration.

All components of society across the planet have a role to play in mitigating climate change, including international organisations. How the OSCE and its participating States take on, and follow-through in, this role will directly reflect on their leadership in the world. Organisations such as the OSCE, NATO and the EU recognise the severe challenges that climate change has brought and cannot hope to declare organisational values that underscore the importance of peace and international stability without intentionally choosing adequate levels of climate action (Barnhoorn, 2023). OSCE climate action can reinforce transparency around allocations to national defence spending, and even potentially avoid impacts on military recruitment and retention if citizens perceive organisational values that are disconnected from their own.

[5] The twelve CCASCOE sponsoring nations are Canada, Denmark, France, Germany, Greece, Italy, Latvia, Luxembourg, Norway, Romania, Türkiye, and the United Kingdom.

Enhancing transparency and consistency in military GHG reporting

The OSCE's approach is that 'military security and stability can be achieved through greater military transparency and openness.' (n.d.d, para.1) Because almost every country has set a national GHG reduction target, it is critical that governments understand the make-up of all their emissions, including the contribution from their respective armed forces. Low quality inventories will affect a country's ability to track and meet their climate targets. Governments, including their armed forces, will come under mounting pressure to make improvements, with increased attention from civil society organisations on carbon accountability and recognition that the military is not always fulfilling even minimum reporting obligations.[6] Despite growing momentum on the need for better reporting of military GHG emissions, significant improvements are still needed.

NATO released a new methodology to measure NATO's civilian and military GHG emissions in July 2023 (NATO, 2023d), and has established a research task group, including a sub-group covering climate mitigation (NATO, 2023c). A NATO proposal for carbon footprint assessment has also been put forward (NATO, n.d.). The new methodology covers emissions across the NATO enterprise yet excludes emissions from NATO-led operations and missions as well as any other activities such as training and exercises. The methodology also does not refer to categories relating to warfighting activities (such as landscape fires or reconstruction needs) or how these may be addressed in the future. In the absence of an agreed international approach on military emissions reporting, a proposed framework was published in 2022, including a comprehensive set of additional categories that specifically relate to other military and warfighting activities and that are not given in the NATO methodology (Cottrell et al., 2022). It is important that these warfighting contributions are not overlooked. Given its inherent complexity, little research has been done on the GHG emissions from a conflict itself, although the emissions from Russia's war in Ukraine have been initially estimated (de Klerk et al., 2023). An estimated 150 million metric tonnes of CO_2 are attributed to the first 18 months of the war in Ukraine, equivalent to the total annual GHG emissions for an industrialised country like Belgium (de Klerk et al., 2023).

[6] See https://militaryemissions.org/

Although the new NATO methodology does not cover all emission categories pertaining to military activities, it is a useful starting point to help improve transparency and be applied by the military to initiate their own reporting, develop mitigation targets and establish reporting improvement goals. Some states have already set out ambitions to improve or develop their military GHG reporting based on the GHG protocol.[7] In this way, Slovenia has indicated that the assessment of the carbon footprint of its Ministry of Defence is in progress and will include investments in arms, ammunition and other specific military goods (NATO, 2023a). All State Parties have the obligation under the Paris Agreement to submit reports on their progress to the UNFCCC in a transparent (UNFCCC, 2015) and regular manner. Unfortunately, since data requested by the UNFCCC on military fuel use is voluntary, most countries do not provide disaggregated data, although some countries – such as the US, the UK, Canada, Germany, Norway and the Netherlands – already report some military GHG emission data publicly, under national reporting commitments. In comparison to 2022, the UNFCCC data submitted in 2023 shows no improvement in the provision or overall transparency in military fuel use data. This includes some OSCE pS, which do not provide any useful data on military fuel use.

Overall reporting obligations remain a challenge for many developing countries, including those with large militaries in terms of overall GDP. Research into the consistency, regularity and quality of inventories indicated that over half of the world's developing countries are struggling to reliably and regularly report their emissions (Umemiya, 2023). Emissions reporting is a critical factor for the overall progress assessment of global climate goals. Although inventory capacity has been improved to some extent, many countries still have low-quality inventories and do not provide useful disaggregated military data.

The Paris Agreement also requires each country to submit a Nationally Determined Contribution (NDC), which forms the basis of a country's ability to reduce its national emissions, adapt to the effects of climate change, and communicate a country's efforts to address climate change. Updated NDCs are due every five years and contain information on targets, policies and measures for reducing national emissions and climate adaptation. Countries

[7] The GHG protocol, see https://ghgprotocol.org/.

will be expected to submit updated NDCs in 2025. NDCs rarely refer to the indirect consequences of climate change (Vogler, 2023), such as migration or potential conflict, but they also typically fail to mention the contribution that the military could make to GHG emission reductions. In some cases, the military is explicitly exempted. Australia, for example, as an OSCE Asian Partner for Co-operation has committed to reduce the emissions of the government to net zero by 2030, but this excludes defence and security agencies (Australian Government Department of Industry, Science Energy and Resources, 2022).

Improvements are needed across the board as far as reporting is concerned, through target setting for, and inclusion of, the military in national reduction targets and their NDCs. The OSCE's core aim on strengthening confidence and security relies on the exchange of military information, dialogue and openness, which means that this should also include transparency around military GHG reporting and reduction target setting (OSCE, n.d.c).

Collaborating on military GHG mitigation action

In addition to supporting collaboration on military emissions policies and transparency of emissions reporting, the OSCE is placed well to promote enhanced standards and physical mitigation activities and initiatives. The scope of mitigation activities required across the OSCE pS' military forces is broad, including technological initiatives, from retrofitting estates and military platforms with renewable energy generation and storage technologies through to developing and testing new technologies (such as synthetic fuel alternatives or portable food and water production systems) (British Army, 2021; DARPA, 2021).

Various armed forces are currently increasing their focus on non-technological components of mitigation, from enhancing sustainability communication, education and behavioural change (Jalili, 2022a) to supporting initiatives for nature-based mitigation, such as afforestation, peatland restoration and sustainable land use practices on training sites (Ellwanger & Reiter, 2019). The ways in which the OSCE could support such initiatives has the potential to expand and diversify, including within the following three areas, in which the OSCE is already well prepared to support current military mitigation action:

1. **Localising political action.** Given the number of OSCE members that are NATO members as well, the NATO Standardization Agreements (STANAG) system represents a key procedural route for enhancing military mitigation across the majority of OSCE participating States when applied. Since MCD 3/21 encourages the sharing of best practices, such frameworks and guiding principles could be equally followed by non-NATO members. However, implementation of such agreements hinges on political support, particularly in terms of finances and material resources. NATO has managed to circumvent some of the resource challenges through programmes such as the Connected Forces Initiative (CFI) (Derleth, 2015). Maintaining political will is key, and the implementation of mitigation criteria within STANAGs is at risk from the relative inexpediency of this issue. The OSCE's Aarhus Centres provide an alternative route through which political pressure can be applied from the 'bottom up' by supporting communities and local action groups near military installations regarding the requesting of information, participating in decision-making on local emissions and pollutant risks, and implementing local mitigation strategies in cooperation with local military representatives (Sehring & Buttanri, 2018).
2. **Enhancing public-private partnership and collaboration.** The OSCE's Environment and Security (ENVSEC) Initiative already provides a valuable resource for countries seeking to develop implementation plans for adaptation and disaster risk reduction. As a part of this, it has gained significant experience in facilitating public-private partnerships between state authorities and actors of the private sector in the fields of energy production and environmental management (Diaz Galán, 2019). This facilitation has not only provided adaptation gains for various areas in Eastern Europe, the Southern Caucasus and Central Asia, but also has highlighted the opportunities for creating resilient water and energy production and distribution agreements (including in areas affected by environmental disasters) (Diaz Galán, 2019). This represents a potentially significant resource for military leaders involved in mitigation initiatives. In this way, leaders engaged in developing or integrating sustainable technologies or in analysing force development strategies could benefit from examining the degree to which these technologies or strategies could help generate or support greater resilience in communities affected by ad-

verse climate conditions (Teicher, 2019). Perhaps the most obvious areas are the refinement of strategies and practices for ecosystem restoration, anti-poaching, stabilisation and Humanitarian and Disaster Relief (HADR) missions, and the testing of viable technologies for sustainable energy and staple production. The OSCE has the potential to act as a form of "trusted intermediary" in supporting the integration of expertise in military practice, policy and education (Teicher, 2019; Jalili, 2022a). Perhaps most importantly, OSCE networks can support dialogue and community engagement in the fields of resource management and circular economy, such as the development and use of biofuels and synthetic fuels, and critical minerals for battery production and electrification (Mirumachi et al. 2020).

3. **Enhancing equity across OSCE security forces.** Although many armed forces are voicing concern as far as climate risks are concerned, there is a risk of cross-force inequity in the drive towards reducing military emissions. Among OSCE pS, the security forces that tend to be the most vocal about reducing their GHG emissions are also generally those with the highest emissions (particularly the USA, but also the UK, France and Germany). This could be seen as beneficial, as the emissions of these larger security forces represent the vast majority of OSCE pS' military emissions and, thus, their buy-in would be integral to any OSCE reform agenda. However, it also presents notable areas of risk. As highlighted by Brzoska, the threat posed by climate change has been used by military forces as a rationale for expanding their relative capabilities and roles, rather than moving towards 'leaner' or 'greener' models (2015).
4. Armed forces of smaller OSCE pS may also be notably concerned that major nations will shape mitigation discourse in ways that privilege their own priorities. This is particularly acute as far as the question of mitigation technologies is concerned. For example, if such forces seek to take the lead as 'first movers' by developing their own capabilities, they may capture certain technology markets, fail to develop workable products, and divert finances from more affordable and interoperable systems (Workman et al., 2022). This is particularly risky if these forces defer the historical, socio-organisational bias towards more expensive and less expendable "exquisite" technologies (Center for Strategic & International Studies [CSIS], 2023).

5. Military forces, however, seek to adopt a 'fast follower' approach, in which they seek to take advantage of decarbonisation technologies from the wider marketplace, buying them as and when required. This has the benefit of rapid adaptation and increasing the demand signals for products that would be affordable and interoperable with smaller military forces. However, it also creates risks, such as causing a reliance on external industry partners and increasing the prospect of a moral hazard (in which, i.e., capability officials continually defer sustainability investments in the hope that a 'silver bullet' technological solution is just over the horizon) (Wagner & Zizzamia, 2022). These risks are a cause for concern given the continued lobbying and political support for the defence sector (including the defence industry) to remain exempt from various environmental laws and regulations (PAX, 2023).

Conclusion

Success will require tremendous political leadership to be sustained over the extended period needed to address climate change. Within the OSCE and other multinational organisations, this could be done effectively through a platform for dialogue on climate change, increased understanding of how to achieve consensus, and mainstreaming, since more ambitious targets for the military will be required to effectively meet the challenges ahead.

The OSCE's network of Aarhus Centres (OSCE, n.d.a) and the Environment and Security Initiative (OSCE, n.d.e) could provide the necessary platform to support the necessary dialogue for, and consultation on, addressing the military emissions reporting gap, thereby focusing on the transparency and clarity of the status of military emissions data, and dispelling concerns over national security from data sharing, the need for inclusion within NDCs, and setting out expectations for military GHG reduction targets.

OSCE pS will have to look beyond individual interests, share best practices and technologies, and contribute to the enabling conditions necessary for innovation and transformation, while avoiding drawn-out internal discussions that water down targets and delay actions. Public diplomacy and outreach efforts must then communicate these targets through the media, conferences, technological demonstrations and other venues.

OSCE pS should be transparent in their actions and with information and data wherever possible, not only to build trust, but also to facilitate discussion and research among civil society and communicate how progress is ensured across the OSCE and its participating States.

The OSCE's role around equity across the armed forces is particularly valuable. Its historical role and influence as regards dialogue facilitation, mediation and confidence-building activities places it in a position to avoid disconnects and disenfranchisement in terms of the technological capabilities of OSCE pS with larger armed forces and those with less developed forces (Schaller, 2021). This could become particularly important in view of the nascent NATO Centre of Excellence for Climate Security and the NATO Science and Technology Committee (STC). In addition, the OSCE can encourage information sharing, joint exercises and capacity-building initiatives to bridge the military mitigation gap between its NATO and non-NATO members.

The OSCE should also encourage new norms and policies to be adopted, which are aimed at mitigating activities across both the armed forces and the wider defence industry, and which are aligned with principles and regulations that are critical to achieving the UN Sustainable Development Goals (SDGs). Doing so calls for transparent reporting mechanisms to be in place to demonstrate the effectiveness of the military climate action policy and allow its measurement against GHG reduction targets.

In July 2023, the OSCE Secretary General suggested establishing a Climate Fund to support participating States and the vital work needed (OECD, 2023). The OSCE's MCD 3/21 acknowledges that climate change requires the widest possible international co-operation, and as such opportunities exist for the wealthiest OSCE participating States to spearhead funding mechanisms (Greminger et al., 2021) as a means of enhancing sustainability investment and innovation among less wealthy OSCE participating States, for example through a centralised fund, as has been similarly proposed for NATO (Shea, 2022). However, any future funding for mitigation initiatives must be measured against net GHG reductions achieved across the military sector. The MCD 3/21 sets out the platform to achieve the necessary international co-operation, and in doing so national military climate mitigation plans, which implement the GHG emission reductions needed, must be in place.

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The Challenge of Climate Change for Security

Helga Kromp-Kolb

Climate Change creates significant challenges to security that cannot be met with military means. Uncertain though worst-case scenarios must be, they cannot be excluded and must be prepared for. The international trust needed can only be developed if present wars – declared or not – are ended. It is in the DNA of the OSCE to provide a platform for exchange in difficult times to strengthen co-operation to address the challenges caused by climate change.

What is certain knowledge?

Empirical science

Climate science comprises natural sciences, social sciences and cultural sciences. This article focuses on the natural sciences, i.e. the processes in the atmosphere and their interactions with other spheres, such as the hydrosphere, the cryosphere, the lithosphere and the biosphere. Climate science in the narrower sense is an empirical science and relies on measurements and observations. There can be certainty regarding these, but climate science can never, strictly speaking, provide proof for the causes of natural processes. The theory that global warming is caused by increasing GHG concentrations in the atmosphere is, however, sufficiently tested to rely on, and it definitely explains more observations than any other theory of climate change.

Even though, for practical purposes, the basic hypothesis is not in question, there are many aspects that are less well established and require further research. The Intergovernmental Panel on Climate Change (Mastandrea et al., 2010) has developed a matrix by which uncertainties are rated: Data availability and reliability and the agreement between different explanations for the data are each rated as low, medium or high. When both are high, the results are considered robust and political or economic decisions can be based on them. If both are low, scientific understanding is uncertain and more data gathering, and research are needed. It is essential to emphasize that it is not a question of the number of scientists or the standing of those supporting an explanation, it is the congruity of the explanations that matters.

Present understanding

Global warming, or global heating, as some prefer to call it, has reached a level of +1.2°C compared to pre-industrial levels on the global average. In preparation for the COP21 in Paris, there was a scientific and political consensus that 2°C above pre-industrial levels was the utmost warming acceptable in view of the temperature range experienced during the Holocene (the last 10.000 years), as well as in view of the consequences expected for the global food supply and for extreme weather events. The pledge to make efforts to limit global warming to +1.5°C in addition to keeping warming to "well below" those +2°C in the Paris Agreement was due to political pressure made primarily by the Small Island States. As there was little scientific basis for 1.5°C, the IPCC was asked to clarify whether 0.5°C less warming justifies the associated significant political and economic challenges. What does +1.5°C mean for the climate, for the GHG budget and for the measures that would need to be taken?

To answer these questions, scientific publications over the next few years focussed on scenarios with small temperature increases. The results were surprising, and the IPCC report (IPCC, 2018) concluded that every tenth of a degree of warming matters. For example, at +2°C, 2 billion people would be affected by extreme heat waves at least once every 20 years, while at +1.5°C only 700 million would be affected. At +2°C about 21% of the land area would be subjected to flooding along rivers, at +1.5°C only about 11%; the North Pole would become ice-free in 3 to 5 years at the end of summer in one case, in 40 years in the other. So, the difference between 2°C and 1.5°C is huge in terms of effects.

Many climate elements, as well as parts of the biosphere, respond at even smaller temperature increases than scientists previously expected. Since the effects typically grow exponentially rather than linearly, even small temperature differences or minor misjudgements can have far-reaching consequences.

Current policies lead to a temperature increase of about 2.8°C by the end of the century. Implementing current national pledges will only reduce this rise to 2.6°C for unconditional pledges or 2.4°C for conditional pledges. However, mitigation thus so far has stayed well behind the commitments made

in Paris (UNEP, 2022). Therefore, scientists started looking more closely at what +3°C, +4°C or more warming would mean for the climate and what consequences such warming would have. This will be discussed later.

The farther scenarios move beyond the empirical evidence, the higher the uncertainties involved. These are partly due to ignorance, that is incomplete understanding of the systems, partly due to insufficient data or bad quality data, and partly to issues not yet regarded (the unknown unknowns). Besides there are also those surprises always inherent in complex systems as well as unpredictable, voluntary human decisions.

On the whole, models do very well regarding large-scale average temperatures, but there is less reliability in other parameters. No single-year forecasts can be made, but long-term trends are robust. Regarding extreme events, only statistical probabilities can be inferred.

The relation between global warming and cumulative CO_2-emissions since pre-industrial levels is linear and can be used to derive the amount of emissions that would lead to +1.5°C warming. Subtracting the emissions already made defines the CO_2-budget still available. Due to the uncertainties involved, calculations can be made for different probabilities of reaching the Paris goals. On the global scale 1.5°C could be achieved with 50% probability if 500 Mt of CO_2 were not exceeded, starting 2020. This implies that emissions would have to be reduced by 50% by 2030 and reach net zero by 2050. This enormous challenge cannot be met by purely technological means, it requires transforming the economic and financial systems and developing a new understanding of mankind's relationship to nature.

Budgets for individual countries are typically calculated based on their population, although other metrics are also being discussed. For Austria, the budget at the beginning of 2022 was calculated to be 430 Mt CO_2 if Austria is to contribute its share to reaching the 1.5°C goal with a 50% probability, and 240 Mt CO_2 if the goal is to be reached with 66% probability (Climate Change Centre Austria [CCCA] et al., 2022). At present CO_2 emission rates these budgets would be exhausted by the end of 2025 or 2027 respectively.

What range of developments?

Quality of past climate projections

Before entering into the scenario calculations of the climate models, just a brief reflection on the quality of past projections. As mentioned above, real developments were always found to be within the range of the calculated projections. However, changes in temperature or sea level rise tended to be near the top of the range of calculated changes; model calculations thus definitely tend to underestimate developments. It also means that developments considered more unlikely than such located in the centre of the range, tend to materialize.

This would be of lesser consequence, would not impacts typically increase exponentially with climatic change. One degree warming at 15°C is of a much lesser effect than 1 degree warming at 20°C. This non-linear growth of impacts leads to gross underestimation of risks if defined as the likelihood of occurrence multiplied by impact. Low likelihood and high-impact developments cause the highest risk. Focussing on the temperature increases considered more likely and on those considered desirable might therefore mean that risks due to climate change are grossly underrated.

Climate stabilised at 1.5°C

In the best of cases, the Paris goal is achieved, and climate will stabilise at +1.5°C above pre-industrial levels. Even in this case, the climate would be quite different from the present climate. Maximum temperatures would be 3 to 4°C higher in Europe, and present-day extremes would be normal temperatures. Summers like the heat summer of 2003 would occur every 2-3 years, and on a global level, about 700 million people would live under heat stress. Some cities would not be inhabitable for parts of the year. In central Europe 2.6 months of drought per year are to be expected, in the Mediterranean area even 3.7 months. In northern Europe, 500-year floods could occur every 100 years and globally 70-90% of all coral reefs would be endangered. Sea level would rise by an average of 4 mm/a. In spite of these substantial changes, humanity can adapt to a stabilized climate at +1.5°C – although the Global South would need support (IPCC, 2023).

Self-reinforcing processes and tipping points

In the worst case, self-reinforcing processes and tipping points built into the climate system will not allow stabilization. A simple example of a self-reinforcing loop in the climate system is the increasing evaporation from the oceans as a result of warming. The water vapour introduced into the atmosphere acts as a greenhouse gas and increases warming, which in turn increases evaporation, and so forth. Fortunately, there are also stabilising feedback processes (negative feedback) in the climate system: More moisture in the atmosphere not only increases the greenhouse effect but also facilitates cloud formation. Clouds can reflect the sun's rays and thus contribute to cooling. Because less water evaporates as a result, the greenhouse effect decreases, it becomes cooler and less water evaporates, there are fewer clouds, radiation increases, and the cycle begins again. In total, scientists have identified 41 such feedback processes, 27 of which lead to a gradual or rapid worsening of climate change, while seven stabilise the climate and for the remaining seven it is not entirely clear how they behave (Ripple et al., 2023).

There are also limits in the climate system beyond which a return to the previous state is not possible. Just as snow becomes warmer and warmer as temperatures rise, but melts when the zero-degree limit is exceeded, there are other tipping points in nature that - once exceeded - can no longer be reversed. If temperatures fall below zero again after the snow has melted, the thawed water will turn into ice, but not back into snow. Self-reinforcing processes in the climate system make the crossing of climatic tipping points more likely.

In view of steadily rising GHG emissions over the past few years scientific publications have focussed on tipping points and the consequences of passing them. (Lenton et al., 2023; Kemp et al., 2022; Armstrong McKay et al., 2022; Sharpe & Lenton, 2021; Xu et al., 2020; Lenton et al., 2019; Steffen et al., 2018) Present understanding has identified about 16 neuralgic systems that control the Earths entire climate system. These include, for example, the position and intensity of the Gulf Stream as an engine of the global ocean circulation, the Amazon Forest as an important reservoir of moisture, the monsoon system, and ice sheets at the South and North Poles, including Greenland. Four of these may pass their tipping point at less than 1.5°C warming: the West Antarctic Ice Sheet, the Greenland glaciers, the boreal

forests of the Northern Hemisphere and the coral reefs of the Australian South Pacific. Some tipping points may already have been passed, while we are approaching others threateningly.

Tipping points can reinforce each other. Rockström summed this up in a succinct presentation at the World Economic Forum 2023 with the best-researched example:

> "Accelerated melting of the Greenland ice sheet, due to a warming that is four times faster than the planet as a whole; cold fresh water is released into the North Atlantic, slowing the overturning ocean circulation and thus shifting the entire monsoon system further south. This triggers droughts and forest fires in the Amazon rainforest (another tipping element of the system). Warm surface water retained in the Southern Ocean accelerates the melting of the West Antarctic ice sheet. The North Pole is linked to the South Pole in regulating the stability of the entire Earth system."

This chain of events would mean that Europe becomes significantly colder, drier and stormier, precipitation patterns shift southward, fertile areas dry out, sea levels rise regionally, oxygen supply to the deep ocean stops, affecting parts of the marine ecosystem, and the ocean absorbs less CO_2. Recent studies based on different methods and data types, move the tipping point of the Atlantic circulation forward in time, even into the first half of this century (Rahmstorf et al., 2015; Ditlevsen & Ditlevsen, 2023) Further warming will increase the probability of reaching and exceeding the tipping point.

Hothouse Earth

The long-term development of the Earth's climate system reveals that the Earth, for much of its existence, was much warmer than it is today. Over the last about 800,000 years, a comparatively cold period in the life of the Earth, there has been an oscillation between two semi-stable conditions, a warmer and a cold state (ice ages), one cycle taking roughly 100,000 years. The triggering mechanism for the change from the warm to the cold state and vice versa was the pulsation of the elliptic trajectory of the Earth around the sun. The present warming caused by increasing GHG concentrations, is about to move the Earth's climate out of this temperature range. As paleo records do not show another semi-stable state beyond about 1.5°C this could set it on a path of continuous warming, called hothouse Earth.

If this possibility is taken into account, then the decision humanity now faces, is to either stabilise the climate at 1.5°C or to accept constant heating. As a warming of +1.5°C will be exceeded in the early 2030s - if stabilization is to be achieved, measures are needed that will take effect in this decade. It is this urgency that makes the climate issue so special. Even though these considerations are not based on sound scientific evidence, exceeding these tipping points is "too risky to bet against" (Lenton et al., 2019, p.592). The biodiversity issue is possibly similarly urgent, but it is less well understood and not the subject of this text, although climate change and biodiversity loss are closely interrelated.

Security policy implications

Climate crisis is a societal and a political crisis

Independent of the validity of the hothouse Earth hypothesis, unabated climate change will have serious societal consequences. It is often overlooked that the consequences of climate change are by no means limited to the climate but have considerable impacts on society. The gap between rich and poor will widen, as global warming has economic consequences, mainly, but not only, for the poor. This is true for countries as well as individuals. Many countries find themselves in a climate trap – whatever progress in well-being is made is periodically destroyed by severe climate events, such as tropical storms, floods and heat waves, devastating infrastructure, agricultural produce and land, as well as making people homeless. The struggle for resources – water, fertile land, space to live, … – will increase, and water shortage, food shortage, and sea level rise will lead to mass migration. Attempts of segregation by the "haves" are a breeding ground for terrorism and raise the potential for war (Schwartz & Randall, 2003; Welzer, 2008). This in turn can lead to political instability, food and resource shortages aside from biodiversity loss and loss of ecosystem services (Kemp et al., 2022). These and other processes involved are part of reinforcing loops that exacerbate the issues.

Implementing the international agreement to stabilize the climate critically depends on getting binding commitments from the global south because present and even more so future emissions will be mainly caused by the global south due to its growing population and the rise of a middle class with higher demands on infrastructure and the amenities of life. However, alt-

hough the global south is most strongly affected by climate change, this commitment depends on concessions and financial support by the global north, as there is no doubt that the industrialized nations have caused a substantial part of man-made climate change. So far, the global north has not supported the global south to the promised extent – the global climate fund e.g. is not filled as foreseen by the Paris Agreement. During COP27, after prolonged negotiations, a fund was set up to compensate for losses and damages in the global south, but no decisions were taken on how it should be filled, or which costs would be eligible for compensation under what terms. While science has made great progress in recent years in attribution science (van Oldenborgh et al., 2021), a quantification of the share of climate change in damages caused by extreme events remains problematic in most cases.

Even though the climate issue certainly has a north-south component, it should not be overlooked, that the interests of the fossil and nuclear industries play a significant, if not the dominant role in climate politics. Thus, alliances among countries – north and south – with resources such as coal, oil or gas are not uncommon. And although it is quite clear that the Paris goals cannot be met while coal, oil and gas are being extracted and burned, the final documents of the COPs have only addressed limiting coal extraction.

As US climate activist Bill McKibben (2022) notes:

> "Justice makes progress only through politics. Balancing the world's wealth even a little is the most difficult of all political tasks. But our chances for a liveable world may depend on it." (para.12).

The climate crisis is not the only crisis

The scientists that moved the doomsday clock to 90 sec before midnight in January 2023 remarked that "we live in a time of unprecedented danger, and the Doomsday Clock reflects this reality". The main risks referred to are the risk of nuclear war, heightened by the war in Ukraine, the unabated climate crisis and the collapse of global norms and institutions needed to mitigate risks associated with disruptive technologies and biological threats. Policymakers are not acting fast enough or on a sufficient scale to secure a peaceful and livable planet. "We know what needs to be done, the scientific evidence is clear, but the political will is lacking."

Aside from these crises addressed by the doomsday clock there are other unresolved crises, such as the biodiversity crisis, the refugee crisis, the economic crises following the financial and corona crisis, the energy crisis as a result of the peace crisis, etc. It is well known that the climate crisis is a problem amplifier, but can it also be the trigger of these crises? Do these crises occur coincidentally now, do they reinforce each other or is there something common behind them? And if so, what? Dennis Meadows thinks that the multiple crises could be a consequence of reaching the limits to growth, which, due to globalisation, are being felt all over the world simultaneously. Others attribute the individual crises to different causes. But unsolved problems and the associated chaos induce governments to look for short-term solutions. The focus on such reduces the capability to solve the problems and thus enhances the number of problems and chaos – a reinforcing loop. Unfortunately, in such a situation, societies tend to value safety over freedom, and this encourages centralised or authoritarian decisions, typically taking little account of diversity or scientific evidence. Successful solutions to the multitude of problems become less likely. This could be one factor contributing to the shift away from democracies that has been observed over the last years (Freedom House, 2022). In order to break through these self-reinforcing loops long-term thinking, evidence-based decisions and participatory decision-making must be encouraged.

Full transformation of our way of doing business and of our economy

As described above, the climate at +1.5°C is far from comfortable in many parts of the world. However, in order to achieve the Paris goal a full transformation of our way of doing business and of our economy will be necessary (A. Merkel, 2021.07.15). In doing this, social and economic conditions can be significantly improved, thus solving the climate issue and most of the other issues mentioned above simultaneously. This would be fully in line with the Agenda 2030 of the United Nations and the Sustainable Development Goals.

Relying on renewable energies will completely change the geopolitical situation and some of the present trouble spots of the world will finally find peace. Conflicts might arise over other resources, but the need for these will not be of the same dimension as it was for oil. Communities will profit by producing their own energy and the money that stays in the community can be used to

finance or initiate transformation in other fields. Moving towards a circular economy implies that industry produces more durable and repairable products, and at the same time, ownership will be replaced by rentals for household goods like drilling machines, cars, etc. This will reduce the number of cars produced and, on the road, as will the shift to active mobility as public transport, bicycling and walking become more attractive. Positive impacts on health ensue from less air pollution and noise and more physical exercise. A significant contribution to better health is also to be expected from healthier food – a consequence of organic farming needed to build up resilience of soils against drought and flooding. With reduced meat consumption the available agricultural land can feed the global population even with organic farming.

The educational system at all levels must be re-organised to enhance creativity in children and support their individual talents rather than shape them to fit some norm. Throughout the educational system intrinsic values should be supported and co-operation should be rated higher than competition. A general understanding of systems and their dynamics as well as interdisciplinary thinking should be taught. The economic system must evolve into a system that does not need to grow in order to be stable, and profit as an aim must be complemented by other ecological and social values. This also implies a restructuring of the financial system. A biotope of currencies, each serving a different purpose, might be a way forward. Democracy will need to adapt to the new necessities – essentially it must become more participatory to ensure that the deep cutting changes are developed in accord with society, not overwhelming it.

A good security policy for all eventualities?

Security policies must strive for peace on the one hand, ending present wars, and strengthen resilience on the other, to prepare for difficult times to come. These might as well be a result of mitigation policies in the effort to achieve the Paris goals as consequences of unmitigated climate change.

Striving for peace: The UN Sustainable Development Goals of the Agenda 2030 essentially represent two agendas: The human security agenda and the planetary boundary agenda. The challenge is to achieve both synergistically and avoid competition between them. The Agenda 2030 also states:

> "We are determined to promote peaceful, just and inclusive societies, free from fear and violence. There can be no sustainable development without peace, and no peace without sustainable development."

So far, little to no progress has been made in this respect – on the contrary, the number of wars raging – whether declared or not – and the intensity and brutality of these is increasing. Wars do not only destroy lives, health, infrastructure and nature, they also destroy trust. But without trust global problems such as climate change or biodiversity loss cannot be solved. Therefore, cease-fires and peace negotiations are of great urgency. A precondition is for political leaders to talk to each other.

Striving for peace or at least non-violent co-existence is at the core of the OSCE mission and can be considered an important contribution towards achieving sustainability. However, this does not exonerate individual countries from making their contribution. Neutral countries would be ideally placed to take a leading role in this endeavor, and Austria with its history of mediation more specifically so. However, now being a member of the European Union makes it more difficult for Austria to regain the role it had e.g. under chancellor Bruno Kreisky. The Austrian government would have to become more serious in maintaining its neutrality, as was agreed during the accession, and the European Union would be well advised to accept such a role being played by one of its members and refrain from pressing for conformity in issues that touch upon neutrality.

Strengthen resilience: The OSCE has, in Decision no. 3/21 "Strengthening co-operation to address the challenges cause by climate change", recognized the importance of the increasing challenges of climate change for the economy and the environment. It calls on participating States to individually and jointly address the challenges of climate adaptation and mitigation of adverse impacts by raising awareness, research and innovation, inclusion in national or domestic strategies, etc. It encourages participating States to make use of the OSCE as a platform of co-operation. Implementing these suggestions would not only reduce negative impacts of climate change, it would also enhance resilience against climate change and thus diminish risks of societal and political instability. At the same time, engaging in joint efforts would offer an opportunity to build-up trust amongst those involved.

The OSCE paper does not enter into a discussion on the extent of climate change that needs to be dealt with. What is needed to prepare the world for a +1.5°C climate or for hothouse Earth and for possible outcomes that lie between? Have security policies been developed for each of these outcomes or for the paths leading to them? Sensitivity to climate change, impacts and timing vary for different parts of the world, thus increasing inequity. What must be done to avoid violent conflicts under each of the pathways and scenarios and how can the challenges that go with them be met – e.g. strongly enhanced migration? In addition to the provisions listed in Decision no. 3/21, foresight work must be done, looking at a range of climate scenarios, including worst case scenarios, and the ensuing hot spots of problems. The OSCE should encourage on such analyses and give support in working out measures to prevent violent conflicts from arising at the local, regional or global scale.

Political and diplomatic co-operation at national and international levels is essential; it is clear, that the structural problems underlying climate change cannot be solved by military operations. These would but exacerbate the problems. Resources, intellectual capacities and political will must be focused on solving the problems underlying climate change and e.g. biodiversity loss, not obscuring them or delaying their resolve. The world is in a crisis and leaders need a crisis mentality. OSCE might contribute to making this understood.

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On Historical Climatology: A Brief Introduction

Felix Schneider

Shortly before his death in 1858, the great naturalist and polymath Alexander von Humboldt speculated that humans, through the massive destruction of forests, could influence the broader climate. A hypothesis that was both daring and accurate, considering that Alexander von Humboldt lived in a world that – by today's CO_2 standards – would seem almost paradisiacal. In the mid-19th century, our planet was home to just about 1.2 billion people; the internal combustion engine had not yet been invented, and the Anthropocene did not yet have a name.

The industrial heart of Berlin during the time of Alexander von Humboldt, the so-called "Feuerland" in the suburb of Oranienburg, painting by Karl Eduard Biermann, 1847. (Wikimedia Commons, 1999)

Even before anthropogenic climate change, the climate – or, more accurately, the change in climatic conditions – had always been a determining factor in the societal evolution of Homo sapiens.

The scientific findings of the last few decades leave no doubt that the constant shift between cold and warm periods – essentially "natural climate change" – has always had immense effects on the development of flora, fauna, and indeed humans throughout the entire evolution.

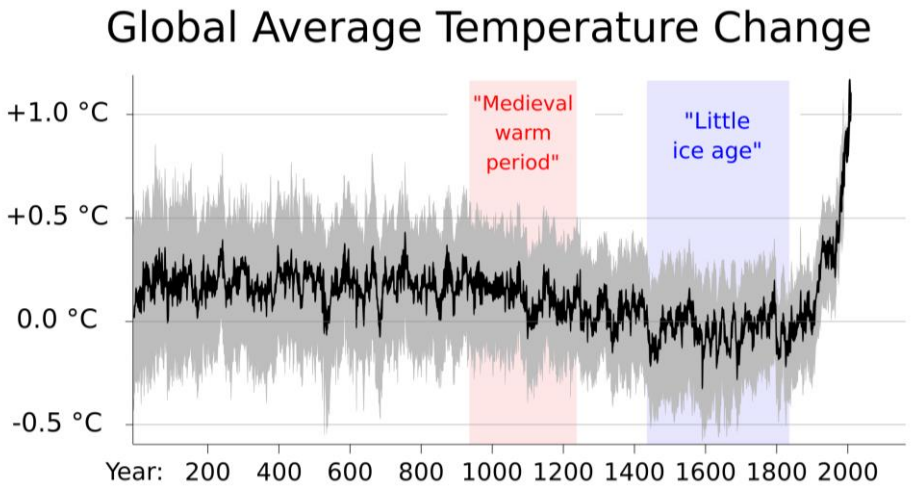
Today, we live in a post-glacial period. Ice ages are defined in such a way that warm and cold periods alternate within these long-term climate periods. Even these glacial and interglacial phases are further divided into so-called stadials and interstadials, meaning shorter-lasting cold and warm periods. Humans today live in an interglacial of the Holocene, a post-glacial age, which began about 11,700 years ago.

Historical Climatology broadly deals with the impacts of the ever-changing climate on human society. It's a relatively young science, akin to a science in its infancy. Its object of study is human society itself, and its findings hold significant importance for historical research. Just a few years ago, the assertion that the climate had a decisive influence on human development would have been somewhat controversial: One would have easily been lumped in with old-school climate determinists, shaped by colonial thinking, who claimed less than a hundred years ago that climate was the determining factor for a people's intellectual development and thereby, as if divinely ordained, determined its standing among the world's cultures.

As it goes with fundamentally new insights, the idea of considering the climate factor also needs its time before it can take its deserved place in the literature. Even today, in standard historical works – or especially there – you will find little or no mention of the influence of climate (or even climate change) on the development of humanity. Textbooks and prevailing opinions are sometimes marked by strong forces of inertia (Mauelshagen & Pfister, 2010).

Pioneers of Historical Climatology, such as the French historian Emmanuel Le Roy Ladurie or the British climatologist Hubert Horace Lamb, delved into the history of climate and scientifically analysed the development of hu-

manity in the context of climatic anomalies. In his 1967 work "Histoire du climat depuis l'an mil", Le Roy Ladurie for instance focused on the "Little Ice Age" (15th-19th century), while Hubert Lamb coined the term "Medieval Warm Period" (11th-12th century).



Medieval Warm Period and Little Ice Age. (Wikimedia Commons, 2020b)

As previously mentioned, historical climate research is still a very young science. It wasn't until the mid-20th century that there was an intensive examination of human history in relation to climate change. At that time, the focus was initially on the so-called "Little Ice Age" and various shorter warm periods, which for the first time could be substantiated by scientific data from the past 2,000 years. The significant comparison that could have been made with the 20th century was initially overlooked. Only in the 1990s anthropogenic climate change did gradually become a topic of Historical Climatology as well.

From this perspective, in Historical Climatology, there are generally two "climate-changing" phenomena to distinguish: On the one hand, we have "natural climate change" and its impacts on the history of human societies. On the other hand, particularly for a deeper understanding of our current climatic situation, man-made (anthropogenic) climate change is what is, quite literally, "burning at our fingertips" today.

Many problems in today's historical scholarship stem from the fact that the history of climate is still very rarely understood as an integral part of historical events. Given this, it is not surprising that historical climatology is only slowly being integrated into our overall historical thinking. To give a very basic example: the history of the Arctic, for instance, can no longer be fully presented without also addressing anthropogenic climate history. It is high time that *climate history*, alongside the classic three core parameters *economy, culture*, and *politics*, finally takes its place as a solid fourth pillar in historical considerations.

One of the fundamental problems of weather and climate observation is the limited lifespan of the observer, Homo sapiens itself. Fortunately, we live in times when (at least in the so-called "First World") men and women can expect a lifespan that already extends well beyond the age of 80 – but for observing climatic changes, this has hitherto been simply too short. This means that in our recent past, weather observations, if they were recorded at all, depended on the existence of written records. And it is here that civilized Homo sapiens quickly reaches its historical limits.

Gods and Scholars – on the Availability of Sources

As for investigating past climatic changes, science has several options. One of the most famous examples is tree rings. The oldest trees on our planet are over 5,000 years old. Yet even this span of time, seen from a climatological perspective, is still relatively short. Ice cores, for instance, provide further insights into the climate that prevailed hundreds of thousands of years ago. The "ice archive" of Antarctica can offer insights into the last 800,000 years of climate history. Stalactite caves are also highly valued as excellent "preservators" of climatic events, as they accumulate "weather data" in the form of stalactites over long periods, shielded from the outside world. Data from coral reefs and pollen analyses even allow inferences spanning several tens of millions of years. However, a geologist will only smile at all these timeframes. The oldest rocks and minerals on our planet are over four billion years old. Thus, it is primarily sediment formations that provide us with insights into the oldest climate history of our planet.

But back to the history of humanity. At this point, allow me a particularly basic question: Since when has the term 'climate' even existed? The concept

of climate is a recent one. Definitions of climate are as numerous as they are diverse. A common one defines climate as the totality of weather values averaged over a longer period (usually a reference period of at least 30 years) in a larger geographical region. And this is where historians face a significant problem: Without consistent records, long-term observations couldn't naturally be conveyed to future generations. And the lifespan of a Stone Age observer, of course, wasn't sufficient to make genuinely scientific statements.

But – and the question is allowed here – why would a Neolithic 'Ötzi' have wanted to study the weather for regularities and anomalies? It is assumed that, up until the modern age, humans mainly considered weather and natural phenomena to be the responsibility of one or more deities. It wasn't until the Enlightenment in Europe at the end of the 17th century that the scientific ball began to roll slowly. One of the most famous representatives of the Enlightenment, Galileo Galilei, is credited with the quote, 'We must measure what is measurable, and make measurable what is not.' From this point on, it wasn't the gods that were in the focus, but humans (Kleinert, 1988).

Let's just imagine for a moment that we ourselves are the Stone Age Ötzi, the man from the Similaun Glacier. And let's further imagine that we are about to cross the Alps under increasingly wintry conditions. In this attempt, we would be caught by a winter storm. Thunder, lightning, and a snowstorm – how would Ötzi have judged this weather phenomenon? Would he have cursed about another Adriatic low? Would he have blamed an unfavourable combination of air layers? Hardly. The man from the Similaun Glacier would most likely have held the gods responsible for the weather. Ötzi might have perceived the sudden winter storm as a test or even divine punishment. And with this assumption, he would probably have been in good company with his comrades of the Chalcolithic Period.

But even if one were to disregard the realm of the gods for a moment: There is another very important factor to consider when accepting climate change: Until well into modern times, due to the lack of scientific research, verified data and the fear of Gods, people were not even aware that the climate changes at all! They expected the weather (climate) to essentially follow a more or less static course, with or without divine influence. The idea of human-caused, anthropogenic change wasn't even touched upon! Even today, this is an inconvenient truth that, sadly, is still widely accepted. Despite glob-

ally accessible clear data and climate insights, science often still faces a significant task in convincing people, at the very least, of our anthropogenic wrongdoings.

It's not surprising that all major ancient civilizations paid the highest respect to their respective weather gods within their pantheons. In fact, in most cases, the weather god was considered the highest of all gods. Weather was a matter of utmost importance. The list of examples is long: It ranges from the Mesopotamian weather god Hadad, the "Lord of Thunder", to the lightning-throwing Greek god Zeus, the supreme Roman god Jupiter, and to the legendary Germanic thunder and weather god Thor, the "Thunderer". Even in monotheistic Christian belief, the Apostle Simon Peter is often colloquially seen as the "weather god" or at least the one responsible for the weather.

Which brings us to the question: When did "climate" actually become a subject of science?

What is Climate?

In fact, it was the ancient Greeks who first set standards in this context. Our modern word "climate" is derived from the ancient Greek "κλίμα (klíma)". Originally, it referred to the "inclination of the Earth from the equator to the poles". Both Hippocrates (460-377 BC) and Parmenides (515-450 BC) divided the world into "climate zones", which they determined based on the respective geographical latitude. These zones indicated whether a region was cool or hot. But it didn't stop there: The "barbarians" who lived in these regions were also ascribed specific mental traits based on their place of residence. "Climata" as "factors shaping mentality" - an early "climatic determinism" approach that we will encounter again, especially in the race theories of the 19th century influenced by European colonialism.

One of the early eastern "observers" of the subject, whom we know to have contemplated "climate change", was the high-ranking Chinese official Shen Kuo, who lived in the 11th century AD. Shen Kuo was a kind of polymath and is credited with inventing the navigational compass. Shen Kuo was considered the most prominent scientist of the Chinese Song Dynasty and left behind a 30-volume work, the "Mengxi Bitan". This compilation includes his records on meteorology. At the core of his observations of nature was

the realization that the presence of fossilized bamboo in northern regions of China suggested that once the moist-hot "climate" essential for bamboo growth must have prevailed there... These petrified witnesses were therefore also evidence that the weather ("climate") could not be an eternal constant.

The British scholar Robert Hooke (1635-1702) was among the first to conduct regular weather observations on behalf of the British Royal Society. Hooke also reflected on the fossils regularly unearthed in England and ultimately concluded that the Earth must be older than the 6,000 years reported in the Bible – a view that was quite risky during the time of the major witch hunts...

In 1742, still within the climate period now referred to as the "Little Ice Age," the Swiss mathematician Pierre Martel (1706-1767) spent an extended period in the Chamonix valley for research purposes. He subsequently wrote a letter to the British politician and naturalist William Windham, who had also traveled to the area, recounting his travel experiences. In the text that has been preserved to this day, "Voyage aux glacières du Faucigny," he shared with Windham his observations regarding the glacier formations found there. Martel noticed that the extent to which the glacier tongues of the Mont Blanc Massif had advanced must have varied greatly over the centuries. This observation led him to reasonably question whether a different kind of "weather" might have prevailed over longer periods in the past.

A French scientist, the mathematician and physicist Jean Baptiste Joseph Fourier (1768-1830), demonstrated in 1824 through his calculations that the Earth should actually be much colder than it is – based on its distance from the Sun. Fourier posited the theory that this phenomenon was possible only because of the Earth's atmosphere, which acted like a bell jar, thereby warming the Earth's surface. This "greenhouse theory" corresponds to what we colloquially understand today as the greenhouse effect.

The Irish mathematician John Tyndall (1820-1893) subsequently deduced that methane, carbon dioxide, and water vapor were responsible for retaining the Earth's thermal radiation. Tyndall, in his quest to explain the phenomenon of ice ages, travelled to high-alpine glacier regions in Central Europe and proposed that ultimately, over long periods, changes in the concentrations of carbon dioxide and water vapor in the atmosphere must be accountable.

He was the first to conduct scientific measurements in this context, thereby establishing the greenhouse effect on a completely new foundation.

The Swedish physicist Svante August Arrhenius (1859-1927) eventually set early standards for proving anthropogenic factors in global warming. At a time when the combustion engine was still in its infancy and most of the local transportation worldwide was still conducted by horse-drawn carriages, the Swedish researcher and later Nobel laureate predicted in 1896 that the use of fossil fuels by humans would further accelerate the warming of the Earth's atmosphere. Svante Arrhenius forecast an increase of up to 5 degrees Celsius with a doubling of CO_2 concentration in the atmosphere (Universität Würzburg, n.d.).

The fundamental scientific realization that the industrial combustion of coal, oil, and gas would lead to a rise in the Earth's atmospheric temperature is today perhaps the most crucial factor in humanity's desperate attempt to mitigate global warming by reducing these greenhouse gases.[1]

The evidence for this was finally presented by the British engineer Guy Stewart Callendar (1898-1964). In over thirty articles published between 1938 and 1964 on the worldwide emission of carbon dioxide into the Earth's atmosphere, predictions about global warming were developed on a scientific basis for the first time. In his 1938 paper "The artificial production of carbon dioxide and its influence on temperature", meteorological measurement data from 200 weather stations dating back to the 1870s were compiled for the first time. Callendar noticed that the Earth's atmosphere had warmed by 0.005 degrees Celsius annually over the past 50 years, with a calculated emission of about 150 million tons of carbon dioxide. Guy Stewart Callendar estimated that about two-thirds of the emitted carbon dioxide must still be in the Earth's atmosphere – an amount that (back then) caused an annual

[1] However, the Swede born in Uppsala did not only see negatives in human-induced warming. He especially envisioned new agricultural possibilities for the inhospitably cold regions of the world: "Yet it may perhaps serve as consolation that, as so often, there is no harm without some good. Through the influence of increased carbon dioxide content in the air, we hope to gradually approach times with more consistent and improved climatic conditions, especially in the colder parts of the Earth; times when the Earth can bear significantly increased harvests for the benefit of the rapidly growing human population." (cf. Arrhenius, 2012)

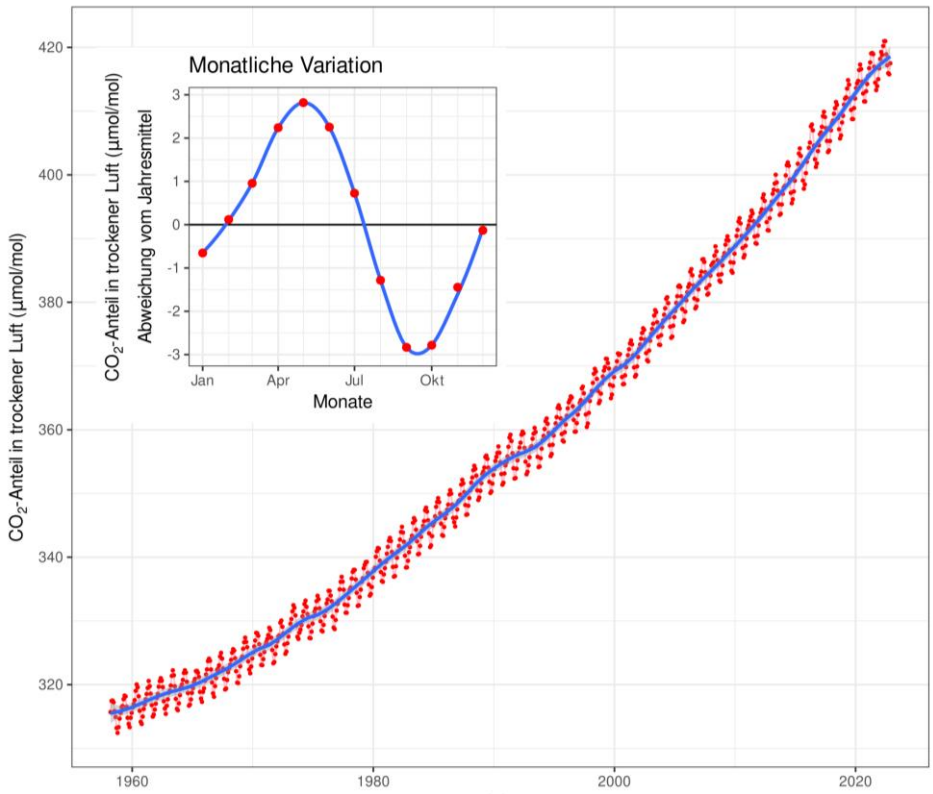
temperature increase of 0.003 degrees Celsius. Based on these calculations, he projected a carbon dioxide concentration in the Earth's atmosphere for the year 2100, which, in fact was already reached by 2013! For in 1938, the Briton's assumed cumulative anthropogenic emission was far too low at 4.5 billion tons annually; in 2021 alone, humanity worldwide emitted 37.1 billion tons of carbon dioxide (Statista, 2022).

Guy Stewart Callendar, whose distinction of the greenhouse effect was termed the "Callendar Effect," faced global criticism at the time of his early research (as did the previously mentioned Svante Arrhenius). Nevertheless, he deserves credit for being the first to provide evidence that humanity influences the climate.

Both Arrhenius and Callendar, despite their insights, had found positive aspects to global warming, likely due to their underestimation of the quantities of greenhouse gases that would burden the atmosphere, especially from the second half of the 20th century onwards. The American oceanographer and climatologist Roger Revelle (1901-1991) was among the first vocal advocates to urgently warn against further uncontrolled emissions of greenhouse gases. Together with Hans E. Suess (1909-1993), an Austrian nuclear physicist who emigrated from Vienna to the USA in 1950, Revelle published in 1957 the pivotal article "Carbon Dioxide Exchange Between Atmosphere and Ocean and the Question of an Increase of Atmospheric CO_2 during the Past Decades" (Revelle et al., 1957, p.18-27). The two scientists highlighted the influence of human CO_2 emissions in the atmosphere and the associated effect, namely that the oceans, as the largest CO_2 reservoirs, simply couldn't absorb these quantities anymore (known as the "Suess Effect"). As a result, the atmosphere is being slowly but steadily warmed by industrialization: "Thus, human beings are now carrying out a large-scale geophysical experiment of a kind that could not have happened in the past nor be reproduced in the future." (Revelle et al., 1957, p.18-27)

Another U.S. climate researcher, Charles David Keeling (1928-2005), demonstrated through systematic measurements spanning several decades that the CO_2 content of the Earth's atmosphere was indeed steadily rising. The so-called "Keeling Curve" scientifically documented, based on measurement data, what earlier climate researchers (as mentioned above) had hypothesized based on their own observations over the years. However, due to

the lack of advanced measurement technology, they hadn't been able to conclusively prove that industrialization by humans played a pivotal role in the constant warming of the Earth's atmosphere. Measurements began in Hawaii in 1958, and within a few years, it became evident that there was a consistent rise in the CO_2 content in the atmosphere, which seemed to have global consequences. By the 1990s, for example, it was demonstrable that, due to global warming on the Northern Hemisphere, spring began about a week earlier than before the measurements started in the 1950s. The burning of fossil fuels by humans was clearly to blame. The term "global warming" was coined.



Monthly average CO_2 concentration 1958-2022. (Wikimedia Commons, 2019a)

Climate Change as a Driver of Human Development and Violence

Weather-related extremes, which are increasing in number due to climate change, will have long-term security policy implications. This has been the case in the past as well. As alluded to at the outset, even history itself is facing new challenges. These challenges manifest themselves in the future (and retrospective) consideration of a new parameter that needs to be integrated into the existing catalogue of historical elements – politics, society, and economy. The climate, or more specifically climate change, is responsible for the rise and fall of great empires, realms, and even entire advanced civilizations. On the other hand, it cannot be denied that climatic changes can also produce regional winners, who were (and are) able to derive immense benefits from the new climatic conditions. In the following pages, through various examples, the historical power of climate change will be demonstrated.

Climate Change as the Ignition of Human Development? The Holocene Climatic Optimum

With the onset of agriculture and animal husbandry about 12,000 years ago, humanity began that phase of societal development upon which we ultimately stand today. This transition, understood today as the "Neolithic Revolution," started replacing the hunter-gatherer cultures that had existed since the Paleolithic era, eventually leading to the permanent settlement of most people.[2]

The epoch of the New Stone Age had begun.

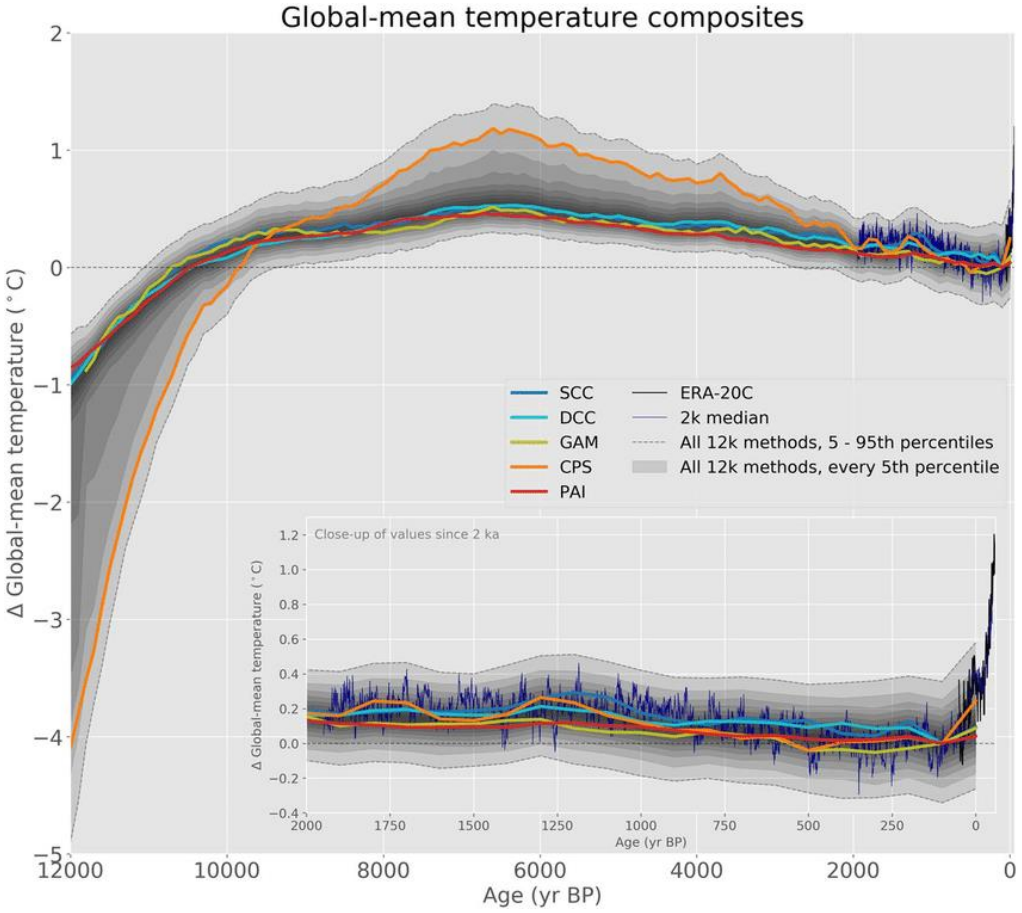
Even though this shift wasn't abrupt, and hunter-gatherer cultures coexisted alongside the region-bound sedentary farmers and herders for a long time, it's still fair to say that the Neolithic Revolution (or Evolution) represents perhaps the most crucial turning point in human history.

The inevitable question in this context is: Why just then? It's also worth noting that this evolutionary shift did not originate in one region and then embark on a global conquest. Instead, agriculture and animal husbandry emerged simultaneously in various regions worldwide. Based on current knowledge, the oldest sites are located in the "Fertile Crescent," China, and

[2] To this day, the question remains unsettled whether sedentism was a consequence or a prerequisite for the development of agriculture. See, in this regard, as a representative example, Benz (2008).

New Guinea (9500-7000 BC), while sites in Mexico, South America, and Africa are dated about 3-4,000 years later.

A glance at the timeline introduces – in addition to numerous already existing theories – a new one that seems interesting in this context: Precisely when agriculture and animal husbandry began to develop, the Holocene era witnessed a so-called "Climatic Optimum," characterized by significantly warmer temperatures that greatly favoured the development of agriculture. It is plausible to assume that the changing climatic conditions acted at least as a strong catalyst for the transition from hunter-gatherer societies to a sedentary agricultural way of life.



Global temperature fluctuations during the Holocene. Notably, the "climate optimum" around 8000 BC. (Kaufman et. al., 2020)

22nd Century B.C.: The Fall of the Old Kingdom of Egypt

We start at the cradle of Mediterranean cultures with the forefather – a culture whose influence over centuries had a vast impact on the development of the entire Mediterranean region of antiquity – and thereby on the development of Europe. We start with Egypt.

What is it that ultimately binds a state or a political structure? In the context of antiquity, this question can essentially be answered in the same way as if we had posed it in our modern world today. The answer is: stability. Stability for the citizens of a modern political structure just as for the subjects of an ancient great empire. When stability can no longer be ensured, rule begins to be challenged.

In a modern democracy, this might merely be a matter of the next election, but for the Pharaohs of ancient Egypt, it was a question of legitimacy. In the Old Kingdom (2686-2160 BC), Pharaohs were worshipped as gods, and later, starting from the so-called First Intermediate Period (2160-2055 BC), they were seen as intermediaries between the divine realm and earthly events.

When one asks about the most dominant factor of stability in ancient Egypt, historians primarily think of one term: the annual Nile flood. This recurring climatic event was the guarantor of the Nile Valley's fertility and thus the number one factor of stability on the Pharaohs' list.

The ancient Egyptians referred to these vital Nile floods as Hapi, one of the four sons of the god Horus. With him, the Nile floods were honoured as a divine phenomenon, as it was believed that the gods themselves had blessed Egypt with this appearance. In hieroglyphic inscriptions, Hapi is depicted as an androgynous figure holding papyrus leaves, accompanied by frogs or crocodiles – all symbols of the Nile. The divine Hapi embodied fertility itself and was the "Lord of Neper", the goddess of grain...

Today, we know that these floods were not sent by the gods but were a result of the monsoon rains that fall with great intensity in the Ethiopian highlands each year. Most of these rains are collected by the Blue Nile and the Black Nile. In the summer months, a flood wave, sometimes more intense, sometimes less so, regularly surged from the mountains all the way to the Nile delta. The regular floods primarily brought fertile silt, turning ancient Egypt into the grain storehouse of its time.

Stability from a secured food supply and subsequent economic prosperity were the magic words during the great days of the Old Kingdom (2700 to around 2200 BC). When one speaks of the golden period in Egypt today, most people in the region automatically think of the Old Kingdom.

And then, about 4,200 years ago, this period of wealth and prosperity came to a sudden halt. Historians have long pondered what could have been the reason for the abrupt decline of the Old Kingdom.

The 4.2 Kilo Event Analyses of pollen, cave minerals, carbon compounds, and others have shown that between approximately 2250-1900 BC, at least in the Mediterranean region, Mesopotamia, and further to the Indus, a climatic event (or events) took place that is (are) attributed to a temporary (though regionally variable) cooling of the Earth's atmosphere. This is referred to as the so-called "4.2 Kilo Event". (Bini et al., 2017) It is possible that this atmospheric cooling was triggered by enormous local volcanic eruptions.

For the Old Kingdom of Egypt, this climatic anomaly manifested as a series of unusually low Nile floods, the Achilles' heel of the previously mentioned stability. The cause of these droughts seems to have been a sudden and significant reduction in the monsoon rains in Ethiopia. Coupled with attacks from hostile Near Eastern tribes from the north and significant supply difficulties, the political structure of Old Egypt was profoundly shaken in the 22nd century BC. The kingdom temporarily lost its central leadership and suffered from a partial societal collapse. Many great achievements of earlier Egyptian pharaoh dynasties were lost or abruptly halted, including the construction of the pyramids (Wanner, 2016).

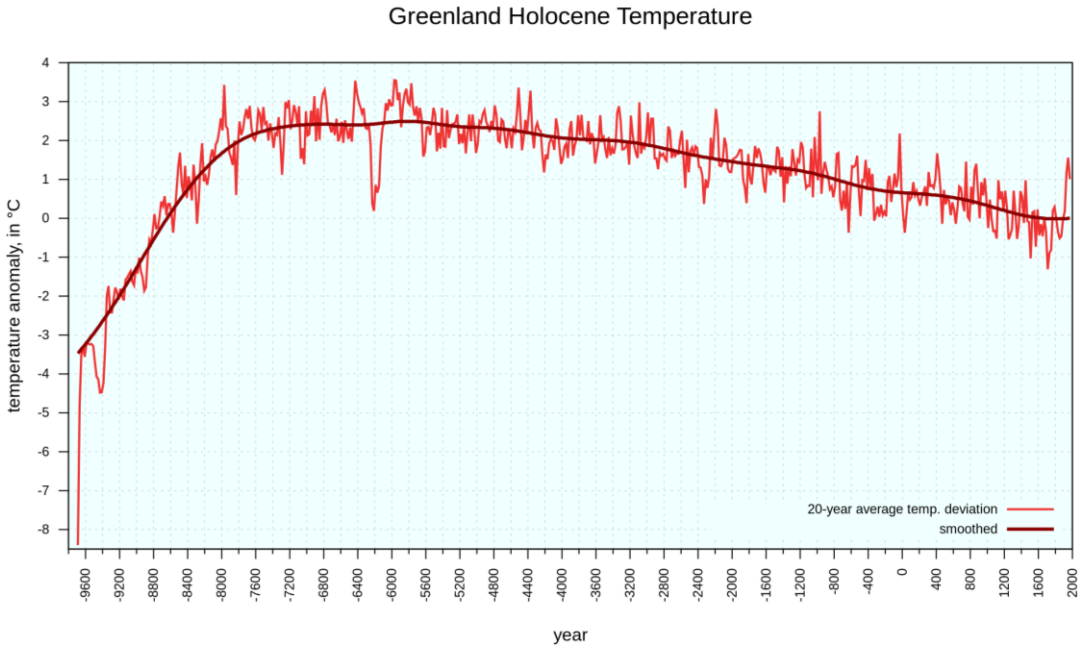
Egypt took more than 40 years to slowly re-stabilize as a centrally governed state in certain regions. However, it did not return to its former glory for a long time, as political turmoil continued to have lasting effects.

Mesopotamia and the 4.2 Kilo Event

Similar catastrophic effects of a sudden onset drought period, which would last about 290 years, were observed in Mesopotamia. The region itself is today known as the first great civilization of humanity, the Sumerian. It was the region between the rivers, where cities like Ur, Uruk, and Nineveh emerged as the first city-states in the 4th millennium BC. This region produced the first complex script, the cuneiform. The legendary Sargon of Ak-

kad is credited with uniting or subduing many of the city-states that existed during the Sumerian era, creating the first unified empire in this part of the "Fertile Crescent," although it lasted only about 150 years.

The Akkadian Empire, alongside the Old Kingdom of Egypt as the second centralized administrative territorial state, collapsed around the same time as the Old Kingdom of Egypt. It's suspected that the sudden decline of the thriving Akkad might also be linked to climate change. Preliminary evidence seems to have been found by researchers at the University of Oxford. In a stalactite cave in Northern Persia (Damavand region), interesting dating of dust particles in stalactites was conducted. They confirm that two major drought periods must have occurred in pre-Christian times in the concerned region (an 8.2 kilo-year event and a 4.2 kilo-year event). One of them coincides with the time of the fall of Akkad (and Old Egypt) (Carolin et al., 2018).

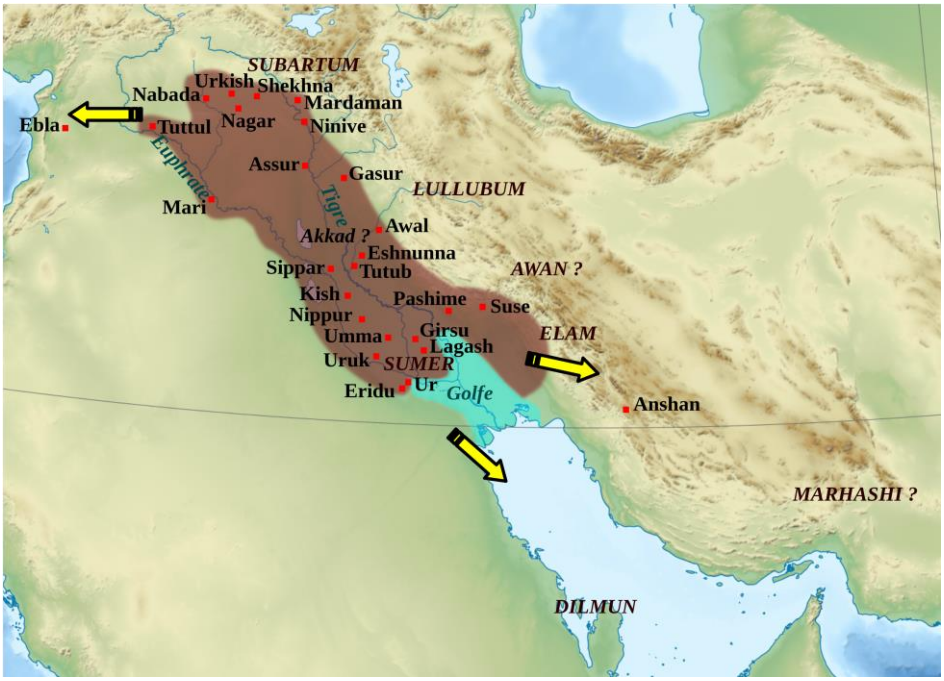


The "8.2-thousand-year event" and the "4.2-thousand-year event" analysed within the context of Greenland ice cores. What stands out is the pronounced nature of the 8.2-thousand-year event. This reinforces the suspicion that the 4.2-thousand-year event may not have had a pronounced global character. (Wikimedia Commons, 2019b)

This makes the previously assumed climate change as the cause of the collapse at least very likely. Additional evidence is provided by an inscription written in Sumerian cuneiform from that same period, which tells of a "Curse of Akkad": "*...large areas of farmland produced no grain, the flooded fields no fish, and the irrigated orchards neither syrup nor wine. The thick clouds brought no rain...*" (Podbrega, 2019).

Subsequently, Akkad could no longer fend off the Gutian tribes, which repeatedly invaded from the Persian region. Akkad itself was burned down by the Gutians in 2115 BC. Unlike the Old Kingdom of Egypt, there was massive migration from the cities in Mesopotamia during the period in question.[3]

As a result, the entire state structure collapsed in a very short time.



The extent of the Akkadian Empire, which dominated a significant portion of Mesopotamia, and which saw such a sudden end in the 22nd century BC. (Wikimedia Commons, 2010)

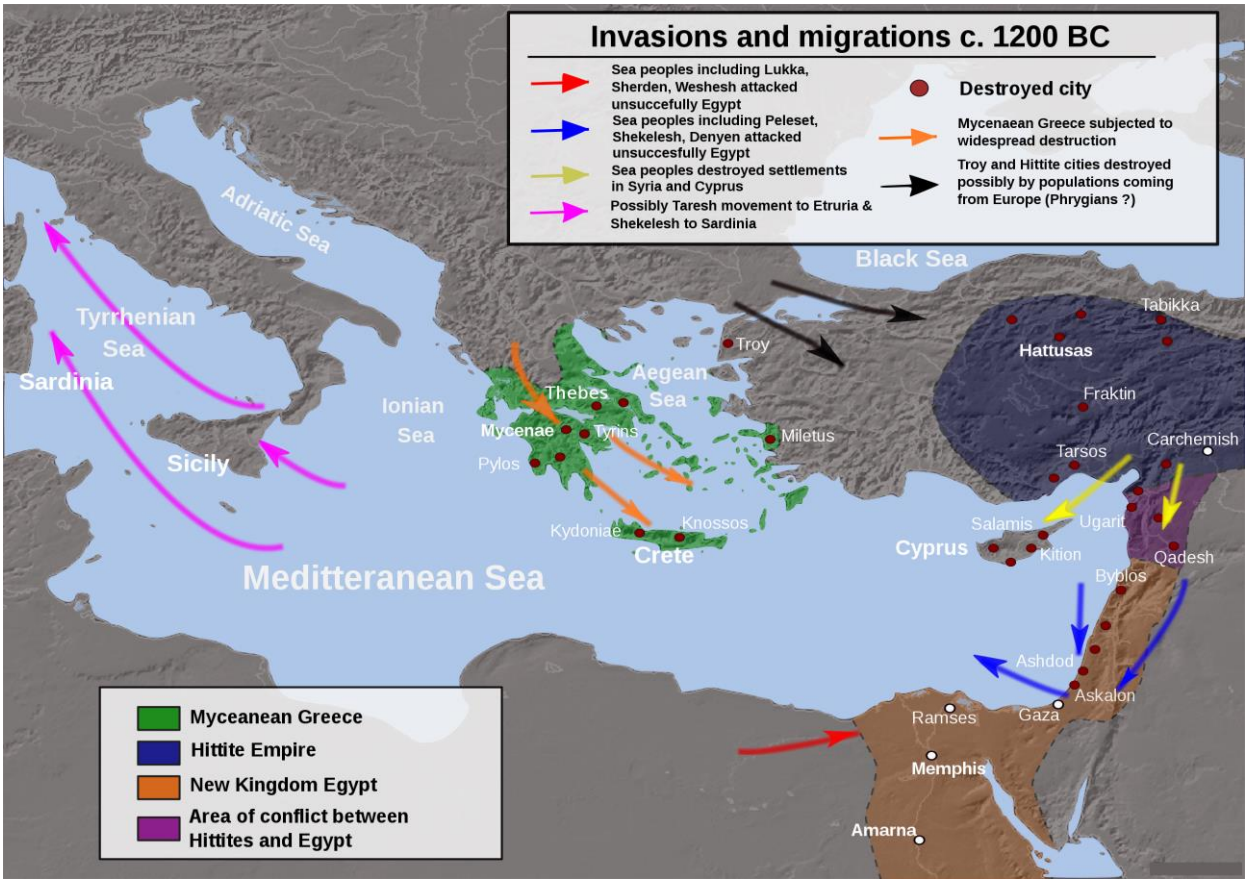
[3] The location of the legendary Akkad, the center of the empire, for example, remains unknown to this day. (Author's note.)

The End of the Bronze Age – An Event Full of Mysteries

Let's stay in the Bronze Age for another chapter. We are now in the 12th century BC, and thus in the Late Bronze Age. It wouldn't be incorrect to describe the great cultures that dominated the eastern Mediterranean at the time as economically "interconnected." These primarily included the New Kingdom of Egypt, which, after plunging into darkness and political instability about 1,000 years earlier, had structurally recovered and continued to be the main player on the southern edge of the eastern Mediterranean. We are now in the timeframe of the 20th Dynasty, the era of the great Ramesses III (1221-1156 BC), which will be discussed in the following.

Trade flourished in the Near and Middle East. For the involved powers, it was a kind of golden age. However, by the end of the 12th century BC, the entire region was shaken by events that left nothing but smoldering ruins from the power centers of Minoan, Babylonian, Mycenaean, Trojan, and Hittite civilizations. Only Egypt managed to narrowly avoid its own destruction.

Until recently, the sudden appearance of the so-called "Sea Peoples" was blamed for this multiple collapse, which today marks the end of the Bronze Age period. Emerging seemingly out of nowhere, they were said to possess superior maritime and weapons technology and ravaged the region in a short period of time, destroying the most flourishing trade network of antiquity and ending the "Golden Age of Antiquity."



The end of the Bronze Age. Can the simultaneous collapse of most of the advanced civilizations in the region be solely attributed to the mysterious "Sea Peoples" who suddenly emerged from historical obscurity? (Wikimedia Commons, 2013)

Was the simultaneous collapse of most of the region's advanced civilizations truly solely due to the mysterious "Sea Peoples" who suddenly appeared from the historical void? In 2014, US archaeologist and historian Eric H. Clyne, with his sensational work "1177 BC. – The Year Civilization Collapsed" (2014) published a study attempting to analyse the backgrounds of this abrupt downfall from various angles. After participating in over 30 excavation campaigns in the relevant region, Clyne concluded that it would have taken much more than fierce pirates to bring such a system crashing down. His theories primarily include the idea that rapidly changing climatic

conditions were the main culprits, leading to instability, famines, and consequently, migrations from the traditional power centres. Pollen analyses from numerous drill cores from the Dead Sea and Cyprus, now supporting this theory, indeed point to sudden regional severe droughts, which must have resulted in catastrophic harvest failures. As already described in the context of the collapse of the Old Egyptian Kingdom, externally advancing hostile tribes (Sea Peoples?) would have had an easier time, as they wouldn't have encountered intact economic and military structures (except for Egypt). It remains debated whether these Sea Peoples themselves were forced into migration by climatic events. The suspected climatic triggers for the drought(s) remain a topic of scholarly discussion. Theories range from volcanic eruptions (Hekla?[4]), altered solar activities, to earthquakes and tsunamis.

Regardless of how the final scientific evaluation of the catastrophe of the 12th century BC ultimately turns out, the end of the Bronze Age serves as a prime example that single-cause explanations for complex events require close scrutiny. Sudden, even if short-lived, climate shifts in a world of fragile, exclusively weather-dependent food supply processes often form the basis for the rapid destabilization of political systems.

Climate Change, Rise and Fall of Rome

Today, the term 'climate change' is exclusively seen as a threatening concept, and it is consistently portrayed negatively in the media – and rightly so. However, if in the third century BC there had been any understanding of climate or even climate change, the term would have been viewed more favourably in Rome for the upcoming centuries. The Roman Empire's meteoric rise during its crucial expansion phase, from around the time of the Punic Wars until the fourth century AD, was not only due to its astute politics and superior army. The so-called "Roman Climatic Optimum," a period of unusually warm weather conditions in the Mediterranean and the North Atlantic during that time, is now seen as another significant factor in Rome's prominence during that era. The American ancient historian Kyle Harper, in his groundbreaking work "Fatum," even went as far as to divide the entire Roman history into climatic periods:

[4] Compare Mühlenbruch (2021), which relativizes Clyne's thesis.

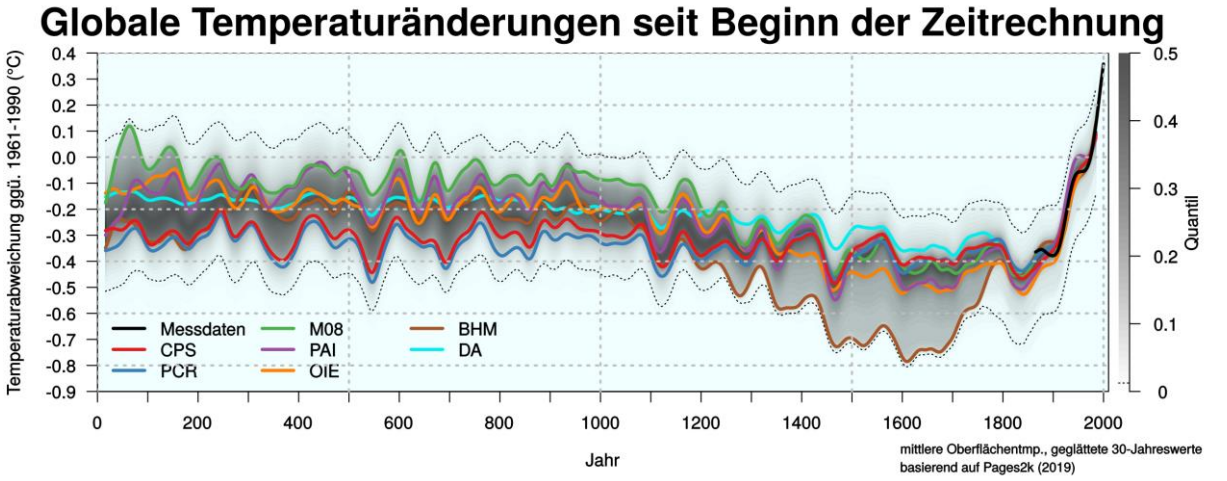
200 BC - 150 AD: Roman Climatic Optimum

150 AD - 450 AD: Roman Transitional Period

450 AD - 700 AD: Late Antique Little Ice Age (Harper, 2020)

The Roman Climatic Optimum allowed the rising power on the Tiber to undertake its expansions against a backdrop of continually improving agricultural yields, thus ensuring a stable food supply in the Roman Empire. The conquered Egypt quickly became the granary of the empire. Yet it wasn't only the inherently fertile Nile Valley that produced unusually high yields during this period, allowing Roman emperors to provide (sometimes even free of charge for Roman citizens) grain supply to the Eternal City. For instance, the Roman historian Tacitus (58-117 AD) reports on wine harvests in southern England (then the province of Britannia). This agricultural boom in the Mediterranean was further enhanced by the excellent Roman road network, ensuring supplies even in the empire's most remote regions.

But even the golden age of Rome had to come to an end. Is it mere coincidence that the fall of the Western Roman Empire coincided with the climatic downturn of the Migration Period?



Global temperature changes since the beginning of the Common Era. The climate low point at the beginning of the Migration Period and the "Little Ice Age" with its peaks in the 16th and 17th centuries are clearly visible. (Wikimedia Commons, 2019c)

Outlook

The framework of Historical Climatology outlined here on these few pages is merely a 'teaser' intended to spark more interest in the subject. The few ancient examples provided could, of course, be complemented by many other (equally interesting) ones, but space constraints prevented this. Popular examples like the "Medieval Warm Period" or the "Little Ice Age" were only briefly mentioned in passing. The intention was rather to call for a new, transdisciplinary approach in historical research, which must be considered if historical events, viewed through the "climate lens," might need to be re-assessed. In doing so, it's also essential to overcome resistance within the profession itself. Indeed, it seems that the clear signs of human-induced climate change were needed as a catalyst for the historical sciences to engage more deeply with this topic.

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Chapter 2

Climate.Changes.Geography.

Impacts of Climate Change on Different Regions

Climate Migration Governance in the MENA Region: Urgent Action Needed

Kira Vinke

Climate change impacts are increasingly affecting drivers of migration, requiring action from nation states and in particular regional organizations like the OSCE. The MENA region, including the six partner countries of the OSCE, is highly vulnerable to further warming effects. Proactive approaches on mitigation, adaptation and migration governance are needed.

Migration can be a collective act of hope: towards liberation from autocratic suppression or the shackles of poverty, freedom from fear. In the context of climate change, migration can be a means to ensure survival, prevent losses and damage and adapt to shifting climatic zones. As all emissions pathways point to further short-term warming, migration will remain a necessity to secure livelihoods. Too often, however, movements of vulnerable populations result in deepening poverty and persistent insecurity. The determinants of the outcomes of migration frequently do not lie with the mobile individuals or households themselves, but rather depend on governance and policies on multiple levels that can enable benefits for sending and receiving communities and people on the move. For this reason, the OSCE could have an important role in shaping political commitments to increase foresight activities to anticipate and avoid forced climate displacement as well as in preventing societal friction, which could evolve from large numbers of displaced people. Furthermore, it can contribute to processes improving the protection of people on the move and strengthen partnerships with countries in Northern Africa, which will experience significant levels of climate migration in the near future.

The Intergovernmental Panel on Climate Change (IPCC) assessed that all inhabited areas of the earth now have observable anthropogenic climate impacts, as the planet has warmed by more than 1°C compared to preindustrial temperature levels (Intergovernmental Panel on Climate Change, 2023). The most apparent effects are more frequent and intense sudden-onset extreme weather events, like floods, droughts, or tropical cyclones. Such climatic ex-

tremes are displacing increasing numbers of people. In 2022, disasters caused more than 32.6 million new displacements, and according to the Internal Displacement Monitoring Center, it was the highest number of disaster displacements in the past ten years (IDMC, 2023). Not all of these displacements are attributable to climate change. In natural climate variability disasters also occur. However, weather-related disasters, which caused 98% of disaster displacements in 2022, are becoming more frequent and severe, and larger numbers of people live in the exposed areas. Between 2016 and 2021, 134.1 million people were displaced by extreme events, especially by storms and floods. Among them were 43.1 million children, whose lives and education were disrupted (UNICEF, 2023).

A diversity of movements requires a diversity of responses

Migration in the context of climate change can take many forms. From adaptive movements, to forced displacement, migration decisions can range across a continuum of voluntary to involuntary (Vinke et al., 2020). Moreover, migration can occur over varying distances, from rural areas into nearby cities, or across international borders. In addition, the temporal scales diverge from people moving short-term and returning after the calamities to those who move seasonally in the agricultural off-season, or those who leave their places of origin permanently. Besides people who move under the impacts of climate change also exist those who do not move. Either by choice or involuntarily, people remain in areas under high climatic stress. Factors determining immobility can include place attachment, financial resources, family ties, gender, age, or disabilities (Upadhyay, Vinke, & Weisz, 2023). This diversity of mobility in the context of climate change highlights that no single policy can fully address the spectrum of climate migration. Also, different age groups, genders and marginalized persons may require tailored solutions to overcome systemic barriers to support. Therefore, a variety of measures is necessary to reap the potential benefits of increased mobility and counter challenges along the cycle of migration.

The IPCC has continuously covered migration since their first assessment report in 1990 (Vinke, Einsporn, et al., 2023). Until today, more than 1900 academic publications have been written on the subject of climate-related migrations (University Neuchatel, 2023). While there are still regions that have been understudied, the relationship between climatic and environmen-

tal hazards and the movement of people has been documented in a variety of socio-economic and geographical conditions (Hoffmann et al., 2020). A meta-study identified a strong climate migration nexus in research on middle-income countries with high agricultural dependence (Hoffmann et al., 2020).

Migration can be a form of adaptation to climate change (McLeman & Smit, 2006). Through the sending of remittances, migrants can strengthen the adaptive capacities in their places of origin. Money transfers can be used to increase food security or enable infrastructural investments that can foster resilience. Hence, adaptive migration can also be a coping mechanism to break the cycle of deteriorating conditions and thereby potentially prevent forced displacements.

While poor populations are worst impacted by the changes, also industrialized countries are struggling with higher needs for disaster risk reduction. Under extreme climate impacts, potentially anyone could be displaced, inter alia by severe floodings, wildfires or storms that may destroy even robust infrastructure. For example, popular tourist destinations, such as the Greek or Hawaiian Islands were hit by wildfires, which resulted in deaths and desperate escapes of locals and tourists alike.

Some regions like the South of Bangladesh have benefitted from infrastructural adaptation and disaster preparedness and could through this reduce their vulnerability over the past decades. But as long as global emissions are not drastically decreased, the ramping up of adaptation is a losing battle against increasing shocks. People with livelihoods that directly rely on healthy ecosystems are often the first to suffer from climatic changes. Especially affected are subsistence farmers or fisherfolk. Furthermore, these populations often do not have the skillsets to position themselves well in labour markets outside of agricultural production. If climatic pressures reinforce rural-urban migration patterns, it may be difficult for people to find employment and reestablish a dignified life after relocation. Lack of access to training and education can make work in the informal sector the only viable option.

Therefore, some climate-related movements, in particular those, which are reactive and not planned movements, can push people into a poverty spiral.

Through these movements, migrants may be able to ensure their survival, but they may not be able to uphold or improve their standard of living, which would be considered an effective adaptation strategy (Vinke, 2019). If such negative patterns are fortified by unabated climate change, humanitarian crises may evolve, leading to adverse impacts on human security in severely affected regions.

The human security implications of climate migration

Though voluntary proactive movements may improve human security by enabling access to resources and social infrastructure, forced migration in the context of climate change can worsen the situation of those displaced, as both financial and non-economic losses can occur. The latter can include, for example, the disintegration of communal structures, the loss of cultural ties or adverse mental health effects such as alienation. Immigration can lead to positive economic outcomes for hosting states. But integration into labour markets, health systems, adequate housing and local socio-cultural systems are key factors for migration outcomes (McKinsey Global Institute, 2016). If policies to facilitate integration are not effective, polarization over certain resources such as employment opportunities or housing can occur between incoming migrants and host populations. Moreover, ill-governed poor settlements in larger urban centres can be prone to health risks from lacking sanitation and overcrowding. In some regions, urban slums have been associated with a higher prevalence of crime. Politics of exclusion of vulnerable groups aggravate inequalities and can ignite social strife, especially when additional resource pressures emerge from extreme events. If there are no sufficient resources allocated to host communities, humanitarian crises materialize when large numbers of people are displaced.

Besides these direct human security implications, the wider nexus of climate and migration also requires further analysis. More than 70% of IDPs and refugees originate from the states most vulnerable to climate change (UNHCR, 2023). Moreover, climate change hotspots are also home to large refugee populations, such as is the case in Bangladesh, where nearly one million Rohingya refugees from Myanmar took shelter in areas highly exposed to climate impacts. Where violence and extreme weather events coincide, the situation of conflict-displaced persons may be particularly perilous and can be aggravated when hunger is weaponized by conflict parties.

In line with the OSCE's comprehensive view on security, which allows for the consideration of non-traditional security challenges, the nexus of climate change and migration should be reflected as an action field for deepened collaboration (OSCE, 2021).

Multilevel governance approaches to the protection gap

People who are displaced by climate change are facing a protection gap. The non-binding guiding principles on internal displacement, which could serve climate migrants, are insufficiently integrated into national legislation and often lack practical applications in areas that see high displacement numbers (OCHA, 2004; McAdam, 2018). With regard to cross-border movements, even extreme climate impacts currently do not legally justify a right to asylum because existing regimes do not account for climate change as a driver of cross-border displacement. The cornerstone of international protection, the Geneva Convention, defines the right to protection for cases in which people are persecuted for their political orientation, race, nationality, religion or because they belong to a specific social group (UNHCR, 2010). The convention hence cannot serve the protection needs of people who migrate primarily on grounds of existential climate risks.

In the absence of a framework for the global governance of climate migration, the application of existing legal frameworks and policies to those migrating in the context of climate change is key. This requires action on multiple levels of governance, from building practical solutions on the international level to measures enacted in cities and rural communities. Moreover, the development of mechanisms for better protection of those displaced by climate change in the future is necessary. Importantly, each level should create policies that develop capacities at the respective level. Across all levels of governance, evidence-based messaging on migration motivations and outcomes can help counter populist anti-immigration arguments, which have furthered the criminalization of migration. Public awareness, participation and communication can be crucial for the successful implementation of governance instruments and enhancing protection.

The Global Compact for Migration provides a basis for further action regarding climatic and environmental drivers of international migration (International Organization for Migration, 2018). Widely recognized, the compact

identifies climate change as a factor for consideration in international migration governance. It points to the work of the Platform on Disaster Displacement and the Agenda for the Protection of Cross-Border Displaced Persons in the Context of Disasters and Climate Change (The Nansen Initiative, 2015; PDD, 2019). In the 2015 agenda, the need to provide lasting solutions for people displaced by climate change is outlined, including allowing entry into other countries and applying the non-refoulement principle for people who have already sought safety in another country.[1] Though the calls for protection have multiplied, concrete actions remain rare.

The German Expert Council on Migration and Integration suggests three instruments to close the protection gap for people moving because of climatic extremes, which differentiate between impact-types and intensity (Expert Council on Integration and Migration, 2023). For cases of uninhabitability, the council echoes previous calls from the German Advisory Board on Global Change and other scientists to create a passport, with unlimited rights to stay (WBGU, 2018; Heyward & Ödalen, 2013; Vinke, Gardiner, et al., 2023). In cases of large-scale damage, where temporary outmigration may be necessary, they suggest a climate card, offered on a quota basis and applied similarly to a humanitarian visa. For people affected by slow-onset degradation in their places of origin, the council suggests a climate work visa, which would facilitate access to labour markets in industrialized nations, like Germany.

Recent recommendations by diverse working groups point to the responsibility of industrialized nations with high greenhouse gas emissions towards people displaced by climate change. Also, in the context of the Loss and Damage Fund, which was agreed upon at the international climate negotiations in Sharm-El-Sheikh/Egypt in 2022, the needs of people displaced by climate change and affected by extreme weather during displacements should be considered (The Loss and Damage and Challenges of Human Mobility and Displacement Working Group, 2023).

[1] "[T]he principle of non-refoulement guarantees that no one should be returned to a country where they would face torture, cruel, inhuman or degrading treatment or punishment and other irreparable harm." (Office of the High Commissioner for Human Rights [OHCHR], 2019, p.1).

Practical solutions for people living in displacement situations as well as knowledge building and coordination activities have already been sought by international organizations tasked with the care for refugees and migrants like UNHCR and IOM, as well as a number of non-governmental aid organizations such as Caritas (IOM, 2019; Caritas, 2023; UNHCR, 2021).

On the regional level, frameworks like the Kampala Convention of the African Union (African Union, 2009) could be applied to reduce protection gaps that have not been resolved internationally. Regional frameworks of freedom of movement have proven to enhance resilience, as for example is the case in parts of the Caribbean under the Organisation of Eastern Caribbean States (OECS) and the Caribbean Community (CARICOM). More research is needed in order to improve climate migration governance on the regional level, especially in the Mediterranean and Central Asian regions, which bear significant relevance to the OSCE.

On the local level, imminent needs of incoming migrants are to be met, including the provision of access to basic services and adequate housing. This requires planning capacities in urban administration and also balancing the interests of different entities. Cities can provide vocational trainings and education for incoming climate migrants, potentially targeting also other vulnerable groups in need of assistance in the receiving communities. In places with high climate mobility, researchers have argued for capacity building in so-called secondary cities in order to ease pressure from major capitals and foster polycentric urbanization (Alam et al., 2018; WBGU, 2016). The International Center for Climate Change and Development has suggested investments for building "migrant-friendly" cities to help those moving in the context of climate change (Alam et al., 2018). This approach could be considered in various contexts, for example also in the MENA region.

In addition, city governments need to plan for improving resilience of the urban infrastructure and society in order to address internally rising climate pressures. They may benefit from city partnerships, which can foster knowledge sharing and enable the empowerment of local actors. Through strong, inclusive institutions, which facilitate civil society participation in resolving contemporary challenges, urban centres can become hubs for social and technological innovation. Such potential is much needed in the sustainability sector and with regards to displacement. These innovations can influ-

ence other levels of policies, but problems of coordination may emerge. For this reason, the regional level can serve to improve inter-communal cooperation and identify broader policy needs on the local level that can be addressed by nation-states.

Climate-related movements in the MENA region

Countries in the Middle East and North Africa (MENA) region can become origins, destinations and also places of transit of climate-related migration. While much of the migratory movements in the region have been linked to economic motivations, climate impacts may lead to the demise of certain livelihoods and therefore a confluence of economic and climatic drivers of climate change has emerged (Sobczak-Szelc & Fekih, 2020). High economic dependency on the largely rain-fed agricultural sector in a number of middle-income countries in the MENA region can result in higher susceptibility to climatic shocks (Waha et al., 2017; Schraven, 2023). Moreover, authoritarian governance structures, which are present in several MENA States, can reduce resilience, in particular of marginalized groups, whose interests and experiences are neglected in policy-making around disaster preparedness and climate adaptation.

In a 2°C warming scenario yearly water discharge could be reduced by 15-45% and in a 4°C scenario by 75% until the end of the century, while also facing extreme events of both water scarcity and excess (Waha et al., 2017). Besides challenges arising from increased aridity, in a 4°C warmer world which would materialize out of the continued high use of fossil fuels, temperatures in the summer would rise by 8°C in some areas, including Algeria, Iraq and Saudi Arabia (Waha et al., 2017). Urban heat islands may locally aggravate extremely hot conditions. 65% of all June/July/August months between 2071 and 2099 would see heat extremes that are so far unprecedented in the region (Waha et al., 2017). These combined effects in a high-warming scenario could pose challenges to the habitability of parts of the region in the long-term. At the same time, the population in the MENA region is expected to grow significantly over the course of this century and will double by 2050 compared to a 2015 baseline, with significant differences between countries (UNICEF, 2019).

Regarding the climate-migration nexus, the region has been largely understudied, with few academic articles focusing on specific sub-regions impact types (Ferreira Fernandes & Alves, 2022; Piguet, 2018). Some grey literature recently started to emerge (Aragall et al., 2021; Dagher et al., 2023). However, the impact of rainfall extremes in areas with insufficient infrastructural protection in the context of fragility and weak governance was already evident in the storm impacts in the coastal town Derna, Libya in 2023. Thousands of deaths and 40,000 displacements resulted from the storm which brought high precipitation that led ill-maintained dams to break.

In general, rural-urban migration patterns may be fortified by stronger environmental drivers of mobility in rural areas. Challenges arising from inadequate housing as is currently present in parts of larger cities such as Tripoli, Casablanca or Cairo could be aggravated by intensified rural-urban migration. Cities under comparatively less water stress like Algiers, Cairo, Tripoli or Tunis are expected to become destinations for climate movements in the Northern Africa region (Clement et al., 2021).

The six OSCE Mediterranean Partners for Co-operation – Algeria, Egypt, Israel, Jordan, Morocco, and Tunisia – have been adversely affected by climate impacts and will likely see worsening conditions in the future. Additional warming, especially in hot and arid regions can lead to agricultural and productivity losses. For Northern Africa, freshwater scarcity and sea-level rise have been identified as drivers of outmigration (Clement et al., 2021).

Climate literacy in Northern Africa is, however, generally low, with slightly higher climate literacy in Morocco and Tunisia than in the rest of the region (Simpson et al., 2021). This means that adaptive early migration may currently not be possible for many because of a lack of knowledge about growing challenges.

While pressures are greatest in agriculture and fisheries, the tourism sector, which is particularly relevant for countries such as Tunisia, Morocco or Egypt, can be adversely affected by the rising temperature extremes and thus provide less stable income sources in the future. In Egypt, for example, sea-level rise, besides posing direct risks to coastal cities could also lead to higher levels of salinity in the Nile River, with implications for adjacent agriculture and freshwater supply. In Tunisia, aggravated water scarcity may increase the need for proactive migration as an adaptation strategy (Sobczak-Szelc & Fekih, 2020).

In the south of Morocco, historical displacement due to drought conditions has been documented. However, since the early 2000s drought and water scarcity have been described as more acute, with larger outmigration occurring from some villages linked to agricultural losses (Aragall et al., 2021). Climatic drivers of migration here also mix with a lack of alternative income sources and the perception of better economic possibilities in other areas of the country (Ferreira Fernandes & Alves, 2022). The populations who stay behind are often highly vulnerable, such as the elderly with limited ability to upkeep the agricultural labour. Remittances from younger migrants who work in nearby cities function as a support system for depopulated rural areas. Besides the rural-urban migration of younger rural populations, who often take up employment with low salaries, there also exists rural-to-rural migration from small-scale farms to industrial farms, frequently owned by multinational companies. Many of these jobs taken up by climate migrants in the rural and urban areas are day-labour, often in the informal sector marked by exploitative structures and lacking occupational safety standards, as interview data from the Chtouka region suggests (Aragall et al., 2021). These different examples from the region serve as an illustration of the diverse policy challenges in the climate-migration nexus, which requires further localized assessment.

Projections of future climate migration

Because of the multicausality of human decision-making, including regarding migration, it is difficult to estimate future movements under climate change. Besides the human factor, other uncertainties persist, such as future population growth, distribution of wealth or scale and efficacy of adaptation options. The World Bank projected future internal climate migration in response to slow-onset changes, calculating three different possible scenarios. They found that in a pessimistic scenario, referencing weak emissions mitigation and unequal development, up to 216 million people could be internally displaced in the six assessed world regions by 2050 (Clement et al., 2021). In the North Africa Region up to 19 million people could be internally displaced and in sub-Saharan Africa up to 86 million people in the pessimistic scenarios. While the World Bank strictly refers to internal displacement, it is likely that in these pessimistic scenarios pressures on international borders would emerge because fewer options for internal relocation would exist in a dramatically changed climate. Therefore, the high numbers of displaced

people in sub-Saharan Africa could have implications for the whole continent including in the Mediterranean region. In a high-emissions scenario, the climate could become one of the main drivers, if not the primary driver of internal migration in the region.

However, rapid ambitious emissions mitigation can substantially reduce these numbers by up to 80% (Clement et al., 2021). This implies that whether people will lose their homes in the global south over the coming decades will largely depend on the choices of industrialized nations.

Conclusion

The complex risk landscape climate change is creating requires a number of actors to increase their ambition in financing adaptation and the protection of displaced people. Many OSCE participating States contribute significantly to global greenhouse gas emissions and are therefore responsible for emerging human security risks that climate change is fostering. Moreover, OSCE participating States and their neighbours, trade- and political partners will also be increasingly affected by climate impacts. On mitigation, adaptation and migration governance there is room for deepened collaboration, joint analysis and additional commitments beyond the UNFCCC. Without such engagement, the human capital of those living in displacement will be jeopardized and regional stability undermined. Created at a time of geopolitical division to foster cooperation, the OSCE may have the tools to contribute to averting the intensification of the climate crisis and its effects on the most vulnerable populations. Using these tools effectively will require political leadership that is willing to give attention to those who have become the scapegoats of the 21st century, migrants and refugees.

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Climate Change and Security in South-Eastern Europe: Strengthening Joint Co-operation in the Shar/Šara Mountains and Korab Massif Area

Alina Viehoff and Beatrice Mosello

In cross-regional contexts, tackling the security implications of climate change can be an entry point to fostering broader co-operation, building trust and good neighbourly relations. A project implemented by the OSCE and adelphi in the Shar/Šara Mountains and Korab Massif area in South-Eastern Europe shows how this can be achieved through a participatory and inclusive process. Involving local authorities, civil society and regional organizations, the project develops and implements joint pilot measures that address the threats of climate change and illegal human activities to the rich biodiversity and livelihoods of people living in the area.

To illustrate how climate-related security risks play out in a specific context, and what actions can be taken to address them, the following section presents a case study focusing on the Shar/Šara Mountains and the Korab Massif area in South-Eastern Europe. It is largely based on the work of the Organization for Security and Co-operation in Europe (OSCE) in the region, in partnership with the Berlin-based think-tank adelphi, under the project 'Strengthening responses to security risks from climate change in South-Eastern Europe, Eastern Europe, the South Caucasus and Central Asia'.[1]

The Shar/Šara Mountains and Korab Massif area is a biodiversity hotspot with great natural value. It comprises four protected areas: Korab-Koritnik, Mavrovo, Shar Mountain, and Sharri/Šara Covering more than 240,000 ha, it is one of the largest protected areas in Europe (UNEP, 2010). Natural resources provide important income opportunities and are thus vital for rural livelihoods and the well-being of local communities (Bogner et al., 2021; Keçi & Krog, 2014). However, the region is also highly vulnerable to the impacts of climate change (Alfthan et al., 2015). South-Eastern Europe is in fact anticipated to undergo significant warming, potentially reaching double the

[1] For more information on the project, see: https://www.osce.org/node/521965.

global average (IPCC, 2021a). In addition, there is a likelihood of heightened aridity, increased fire weather conditions, and more frequent droughts by mid-century. The decline in snow cover is also likely to continue and snowmelt is expected to intensify in winter. In combination with more intense rainfall, this will lead to an increased risk of river flooding (IPCC, 2021b; Alfthan et al., 2015). In turn, the pressures caused by the climatic and environmental changes could accelerate regional biodiversity and habitat loss in the region (Vasilijević et al., 2018; IPCC, 2022).

Climate-related security risks in the area

The impacts of climate change, together with unsustainable and illegal human activities, are threatening the rich biodiversity and key economic sectors of the Shar/Šara Mountains and Korab Massif area – posing significant risks to livelihood security of local communities and aggravating challenges that the area is already facing in a number of ways.

Firstly, forests play a crucial role in the livelihoods of local communities, especially in rural mountain areas. Firewood is utilized as fuel and for heating in the area, while timber is used in construction and trade. Forests also serve as a reservoir of biodiversity and provide essential ecosystem services (Bjegović, 2021; EuroNatur, 2020; Keçi and Krog, 2014). However, deforestation and illegal logging, occurring in all four protected areas, are endangering these vital ecosystems (Bogner et al., 2021; Bjegović, 2021; KOSID, 2020). These activities are largely perpetrated by organized criminal groups and networks, but the rural population is also turning to unsustainable deforestation practices due to increasingly difficult socio-economic conditions (Bjegović, 2021; KOSID, 2020; Stefanovski et al., 2021). These issues exacerbate the negative impacts of climate change on biodiversity and thus on livelihood security (Rüttinger et al., 2021). Forest fires aggravate the situation. Many of the fires are human-caused (KOSID 2020), but higher temperatures and more frequent droughts due to climate change also increase their likelihood. This leads to the destruction of carbon sinks and sets free huge amounts of CO_2, in turn exacerbating global warming (UNEP, 2022).

Secondly, the local population of the four protected areas relies on extensive agriculture and livestock farming as a main source of income. However, rural out-migration and the associated abandonment of traditional land use prac-

tices, is challenging the agricultural sector (Bogner et al., 2021; Keçi and Krog, 2014). The decline of traditional farming has resulted in the overgrowth of pastures, thus leading to a transformation of habitats and loss of biodiversity (Bogner et al., 2021). In some areas, unsustainable grazing management and the intensive commercial collection of wild plants is putting further pressure on ecosystems (van Ackern et al., 2022). The impacts of climate change compound these challenges: rising temperatures and less rainfall affect the health of crops and livestock (Lacetera, 2019), in turn exacerbating livelihood and food insecurities in the area. Women are particularly vulnerable to these impacts due to pre-existing economic disadvantages and their low participation in relevant decision-making processes (Rüttinger et al., 2021).

Joint co-operation and action on climate and security

Understanding the dynamics between climate change and security in the Shar/Šara Mountains and Korab Massif area is key to design policies and programmes that address and mitigate them. As the risks are shared across the region, tackling them in a comprehensive and sustainable manner requires enhanced co-operation between the protected areas. Co-operation is also essential to secure the well-being and livelihoods of communities in the protected areas, as well as to strengthen their resilience in times of a changing climate. Beyond this, co-operation on climate change and security issues can offer opportunities to build more trustful and neighbourly relationships in the region as a whole (van Ackern et al., 2023).

In this context, the OSCE and adelphi have been working since 2020 in the region to enhance the understanding of how climate-related security risks play out, foster co-operation among regional stakeholders to jointly address the risks and increase awareness and capacities for an integrated approach on climate change and security. In the Shar/Šara Mountains and Korab Massif area, the project has worked with local authorities, civil society and regional organizations to assess climate-related security risks and develop and implement joint climate adaptation measures.

Initiating joint co-operation to tackle climate-related security risks

The Shar/Šara Mountains and Korab Massif area was identified as a hotspot for joint action to tackle climate-related security risks based on an in-depth assessment of the security implications of climate change in South-Eastern Europe (Rüttinger et al., 2021) and extensive stakeholder consultations in the region. Through a participatory process involving representatives of relevant ministries, respective park management authorities, municipalities, and local Civil Society Organizations (CSOs), as well as experts from the region, international partners, and the OSCE field operations, the project produced a joint co-operation strategy on climate change and security for the Shar/Šara Mountains and Korab Massif area.[2]

The strategy consists of three key elements. Firstly, it identifies co-operation priorities, which include issues such as illegal logging and hunting, fire management, local livelihoods and cultural heritage. Secondly, it highlights opportunities to improve overall collaboration between the four protected areas. Finally, it provides an implementation plan featuring eight initial joint project concepts, involving stakeholders across the different protected areas and in synergy with other local, regional and international initiatives (Mosello et al., 2023). The strategy and the implementation plan have served as the starting point for the development and realization of concrete pilot activities.

Implementing pilot projects for joint risk reduction measures

As of January 2024, two of the eight project concepts outlined in the co-operation strategy are being implemented.

The first pilot project, led by the OSCE and adelphi, aims to support and improve the co-operation among local stakeholders in the four protected areas on the prevention of illegal logging, and strengthen enforcement capacities. As part of this effort, local researchers are establishing a baseline on illegal logging occurrences and are analysing the legal gaps that need to be addressed to combat illegal logging. The resulting study and possibilities for joint action on addressing illegal logging will be discussed with a diverse group of stakeholders working on illegal logging in the area, including park authorities, enforcement agencies, NGOs and CSOs. The goal of this dialogue is to establish a cross regional working group to develop a protocol of

[2] The full strategy can be accessed here: https://www.osce.org/oceea/545791.

co-operation that will serve as the basis for joint patrolling across the four protected areas.

In response to the threats of forest fires, the OSCE, in partnership with the Global Fire Monitoring Center (GFMC), and Regional Fire Monitoring Center for South-Eastern Europe and South Caucasus (RFMC), has launched the pilot initiative 'Fire Resilient Protected Areas: Shar/Šara Mountains and Korab Massif Area'. The pilot seeks to strengthen local capacities and foster co-operation in tackling wildfire risks in the four protected areas. The project team organized several trainings for park management authorities and the civil emergency response units of the municipalities on early warning, fire preparedness and response (OSCE, 2023). In addition, firefighting equipment and hand tools such as forest air blowers, backpack pumps, fire brooms, and protective clothing for firefighters are procured for use by the park management authorities (OSCE, 2023b).

In addition to the pilot projects in the protected areas, the consultative process has resulted in a dialogue on the links between climate change, air pollution and health in South-Eastern Europe – another key climate-related security challenge requiring urgent action (Rüttinger et al., 2021). In this context, the OSCE convened regional representatives of municipalities, CSOs, and academia to discuss the impacts of climate change and air pollution on health, and to explore local solutions and project ideas (OSCE, 2023c). Based on the discussion and to identify best practices, small demonstration activities, such as public awareness raising or youth engagement, are carried out in municipalities across the region.

The work of the OSCE and its partners in the Shar/Šara Mountains and Korab Massif area is a good illustration of the importance of taking immediate action to address the security implications of climate change. Yet, it also shows that addressing shared challenges can be used as an entry point to foster broader co-operation, building trust and good neighbourly relations in the region. To this end, the project demonstrates the need for a truly participatory approach – one that brings all relevant and affected stakeholders on board: ministries, local municipalities, NGOs, CSOs, regional and international partners, as well as the research and private sectors. It also emphasizes the importance of the process being inclusive and responding to the specific vulnerabilities and needs of all groups, including women, and youth.

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Transboundary Water Management, Biodiversity and Climate Change and their Impacts on Local, National and Regional Security: Examples from the Dniester River Basin Shared between the Republic of Moldova and Ukraine

Dana Maria Bogdan

Environmental degradation, the unsustainable use and/or the mismanagement of natural resources and waste disturb ecological systems and risk adversely affecting the stability and security of countries. Transforming threats and risks into opportunities for co-operation and joint engagement is an important focus for the Organization for Security and Co-operation in Europe (OSCE) in tackling environmental and security challenges in the region.

Introduction

"The rate of environmental degradation puts life on Earth at risk" is a statement well-accepted in thematic and policy-related literature and features in a variety of environment-related articles and research across different fields. Similar factual statements and related concepts, such as for example the fact that the Earth's Overshoot Day [that is the day when humanity has exhausted nature's budget for a given year] has steadily shifted to earlier in the year or that humanity is using Earth's natural resources at an unsustainable rate etc. seek to draw attention to the urgency of action in this regard.

While there are various ways to define 'environmental degradation', the term generally describes the deterioration of the environment, through depletion or pollution of resources (air, water and soil), the destruction of ecosystems and the extinction of wildlife.

Further to naturally occurring phenomena (e.g. tsunamis, volcanic eruptions, earthquakes), it is widely acknowledged that human actions, resulting in air and water pollution, soil erosion and desertification, habitat destruction, etc. contribute significantly to accelerating environmental degradation and the scarcity of natural resources. The adverse effects of climate change on human health, ecosystems, and natural resources, particularly water, will only exacerbate existing challenges.

In the context of an increased world population, which has doubled since 1970, and of a steep increase in the global Gross Domestic Product (GDP), which has grown fourfold, the above-described existing challenges are, even more so, to be carefully considered (Oberle et al., 2019). These developments resulted in a constant need for an accelerated exploitation of natural resources to sustain economic development and meet the increased demand for food. According to the International Resource Panel's (IRP) report "*Global Resources Outlook 2019*", the extent of human activities and their impacts is self-explanatory: The extraction and processing of natural resources is responsible for 90% of biodiversity loss and worldwide water stress (Oberle et al., 2019).

The Global Ecological Footprint reflects this trend. As presented in the World Wide Fund for Nature's (WWF) "*Living Planet Report 2022*", the world average footprint in 2020 amounted to 2.5 global hectares per person, compared to 1.6 global hectares of bio-capacity (Almond et al., 2022). In other words, we overused our planet's resources by at least 75%. While the scale of biodiversity loss and the extent of decline of wildlife populations varies around the globe, the same report finds wildlife populations have declined by an average 69% in the past 50 years (WWF, 2022). The future prospects are similarly alarming. An estimated 11% of existing species will become globally and irreversibly extinct due to global land use activities (Oberle et al., 2019). Wildlife trafficking further contributes to biodiversity loss and ecosystem collapse with significant implications for economic development and human health.

In economic terms, the above-mentioned report indicates that global resource extraction has tripled from 27 billion tonnes in 1970 to 92 billion tonnes in 2017 and continues to grow (Oberle et al., 2019). In the absence of drastic change, global resource consumption will double by 2060 (Oberle et al., 2019). The implications of biodiversity loss are as alarming for the economic sector as they are for other sectors. According to the World Economic Forum (WEF) report "*Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy*", $44 trillion of economic value generation – over half the world's total GDP – is moderately or highly dependent on nature (WEF, 2020a). A further WEF report, "*The Future of Nature and Business*", identifies that a nature-positive economy could generate up to $10.1 trillion in annual business value and create 395 million jobs by 2030 (WEF, 2020b).

The depletion and pollution of natural resources already pose and will continue to pose an even more significant stress for the agriculture sector. The Food and Agriculture Organization (FAO) indicates that, between now and 2050, with an estimated population of nine billion, increasingly more water will be required to produce the estimated 60% of extra food needed (FAO, n.d.). Simultaneously, the agricultural sector is the main water consumer in the global economy, accounting for approximately 85% of global water stress (Oberle et al., 2019). Increasing demands for food, water, and energy on a background of reduced or degraded natural resources are likely to contribute to social instability and can exacerbate political tensions or potentially spark new ones.

In the context of the COVID-19 pandemic, the linkage between biodiversity and human health has been discussed at length. In particular, the narrowed natural space between humans and wildlife, due to biodiversity loss, has been often cited as an enabling factor for the spread of pathogens and zoonotic diseases. Some of the causes of biodiversity loss include the unsustainable use of natural resources and of land, including habitat fragmentation, agricultural practices, and wildlife trafficking. These and other factors highlight the important role of biodiversity in sustaining security and well-being.

Environmental degradation can be both a driver as well as a consequence of disasters, including when resulting from armed conflicts. Military hostilities harm the environment and destroy or damage critical energy infrastructure and industrial facilities, leading to the deterioration of water access and water quality, chemical leaks, and growing risks of flooding in the affected territories. These threaten the environment, human health, and security not just in the military theatre, but also in neighbouring regions.

"*Sustainable development cannot be realized without peace and security; and peace and security will be at risk without sustainable development*" is at the core of the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDG). It describes the intrinsic relationship between the SDGs, particularly SDG 14 on "Life below Water" and SDG 15 on "Life on Land" (for the purpose of this paper), and peace and stability (UNDESA, n.d.).

Biodiversity loss represents not only one of the main impediments to attaining sustainable development, but, coupled with ecosystem collapse, is one of the fastest deteriorating global risks over the next decade, as per the WEF's "*Global Risks Report 2023*" (WEF, 2023).

The report notes that…

> "…without significant policy change or investment, the interplay between climate change impacts, biodiversity loss, food security and natural resource consumption will accelerate ecosystem collapse, threaten food supplies and livelihoods in climate-vulnerable economies, amplify the impacts of natural disasters, and limit further progress on climate mitigation". (WEF, 2023, p.8)

As presented above, environmental degradation and its impact on biodiversity, leading to biodiversity loss and ecosystems collapse may impact security in various ways and halt or delay sustainable development. Therefore, an overall approach to ensuring security and safety should be one which integrates the interconnections between these sectors. At the same time, co-operation and collaboration in preventing potential security threats stemming from the degradation of the environment create avenues for bringing countries together and for building trust and confidence. An environment of trust and confidence can be considered as a key prerequisite for conflict prevention.

International frameworks

In recent years, the international community has sent alarming signals about the triple planetary crisis of climate change, nature and biodiversity loss and pollution and waste, as described by the Executive Direction of the UN Environment Programme (UNEP) (UNEP, 2022). The call for a large-scale, international action with the involvement of all actors, at local, national, regional and global levels and across all sectors of society to avoid the worst-case scenario has been stressed on numerous occasions. This has also been enshrined in the *Sustainable Development Goals of the 2030 Agenda for Sustainable Development* through a dedicated Goal – *SDG 17 on Partnerships* (UNDP, n.d.).

In July 2022, in a historic step, the UN declared a healthy environment as a human right. Through the resolution "*The human right to a clean, healthy and sustainable environment*", the UN General Assembly (UNGA) acknowledged that climate change and environmental degradation are some of the most pressing threats to humanity's future (UNDL, 2022). It called on states to step up efforts to ensure their people have access to a "clean, healthy and sustainable environment". While not legally binding, the instrument aims to act as a catalyst for action and to prompt countries to incorporate the right to a healthy environment in national constitutions and regional treaties.

Fortunately, this is not a singular action. In April 2022, the UN Human Rights Council declared access to a *"clean, healthy and sustainable environment"* a human right (A/HRC/RES/48/13) (UNHCR, 2021). This represented the first formal recognition, at a global level, for the right to a clean, healthy and sustainable environment as a human right, and acted as a founding step for the UNGA resolution.

Similarly, a number of international legal standards developed by the Council of Europe – including the European Convention on Human Rights, the European Social Charter and the Bern Convention on the conservation of European wildlife and natural habitats – have successfully been invoked to advance the environmental cause. In September 2021, the Parliamentary Assembly of the Council of Europe (PACE) adopted *Resolution 2400* which acknowledges that…

> "…access to the fundamental right to a safe, clean and healthy environment was unequally shared between regions, countries and individuals, stressing that the effects of climate change impacted poor countries disproportionately, as well as disadvantaged groups, minorities, women and children". (CoE, 2021)

In December 2022, governments around the globe came together for the UN Biodiversity Conference (COP15) to agree on a new set of goals by 2030 aiming at halting and reverting nature and biodiversity loss. A historic package of measures, forming the "*Kunming-Montreal Global Biodiversity Framework*" (GBF), was adopted in the conclusion of COP 15 (CBD, 2022). The Framework includes 4 goals and 23 targets to be reached by 2030 aimed at addressing the critical loss of biodiversity and supporting the restoration of natural ecosystems. Protecting 30% of Earth's lands, oceans, coastal areas and inland water, reducing government subsidies that are harmful to biodiversity by $500 billion annually and cutting food waste in half are among the key issues addressed in the GBF (CBD, 2023). The framework provides, however, a clear set of measures to set humanity in the direction of a sustainable relationship with nature, with clear indicators to measure progress. During the meeting a series of related agreements on the implementation of the GBF were approved, including planning, monitoring, reporting and review; resource mobilization; helping nations to build their capacity to meet the obligations; and digital sequence information on genetic resources.

At the EU level, the main objective to put Europe's biodiversity on the path to recovery by 2030 for the benefit of people, climate and the planet has been clearly stated at the top of the *EU Biodiversity Strategy for 2030* (European Commission, n.d.a). The Strategy, which was issued in 2020, recognizes the multiple benefits of biodiversity for society and, more broadly, for life on Earth and contains clear commitments and actions to be taken by 2030. Among others, a minimum of 30% of the EU's land area and 30% of the EU's sea area must be legally protected, as well as at least one-third of the EU's protected areas. Furthermore, all protected areas must be effectively managed and appropriately monitored by 2030.

As a key element of the above-mentioned EU Biodiversity Strategy for 2030, in July 2023 the European Parliament passed the *EU Nature Restoration Law* (European Commission, n.d.b). This is intended to bring a number of benefits, in particular by increasing biodiversity and thus restoring ecosystems and yielding the associated ecosystem services, restoring habitats and species both on land and at sea. Furthermore, it aims to contribute to limiting global warming to 1.5°C and, equally important, to build Europe's resilience by contributing to the prevention of natural disasters and reducing potential risks to food security (European Commission, n.d.b).

In support of these endeavours, €20 billion are assigned each year for biodiversity through various sources, including EU funds and national and private funding. In implementing these goals, the EU Commission aims to ensure that by 2050, "all of the world's ecosystems are restored, resilient, and adequately protected" (European Commission, n.d.a).

OSCE's engagement

Economic and environmental matters have always been an integral part of the OSCE agenda. Established in 1975, through the Helsinki Final Act, the States participating in the Conference for Security and Co-operation in Europe, the foundation on which the OSCE was created, expressed the conviction that…

> "…efforts to develop co-operation in the fields of trade, industry, science and technology, the environment and other areas of economic activity contribute to the reinforcement of peace and security in Europe, and in the world as a whole". (OSCE, 1975, p.17)

The OSCE has a comprehensive approach to security that encompasses politico-military, economic and environmental as well as human aspects and bases its work on inclusiveness. Within the OSCE, decisions are taken by consensus by its participating States during the annual Ministerial Council, the central decision-making body of the Organization, and form the guiding direction or the so-called mandate.

Based on its established mandate, the Organization assesses potential security risks stemming, wholly or in part, from environmental factors, and supports participating States to implement their relevant OSCE commitments in this field. In the environmental field, the main thematic areas of work include water management, particularly in a transboundary context, disaster risk reduction, hazardous waste, good environmental governance and climate change, all of which are impactful on biodiversity and highly relevant to aspects of security. Through its work, the OSCE provides a platform for political dialogue on risks associated with environment and security challenges, in particular by assessing the interlinkages between the two.

In the area of climate change, while a number of references have acknowledged climate change as a long-term challenge in various OSCE Ministerial Council decisions and documents, and have attracted attention to the fact that climate change may magnify environmental challenges, the foundation document of OSCE's mandate is represented by the Ministerial Council Decision (MC Dec) 3/21 on "Strengthening Co-operation to Address the Challenges Caused by Climate Change" (OSCE, 2021). MC Dec 3/21 calls on the OSCE participating States to intensify dialogue and co-operation towards climate resilience, adaptation, and mitigation including through climate risk analysis, early warning, joint research and investment as well as exchange of information and best practices in the area of technology and innovation. It, as well, calls on the OSCE participating States to promote the effective participation of women in decision-making process in the area of climate change prevention, mitigation and adaptation.

The water management – biodiversity linkage in the Dniester River basin and the impacts of climate change

Situated in Eastern Europe, the Dniester River is one of the largest transboundary rivers in the region. It is the fourth largest river in Ukraine and the largest river in the Republic of Moldova and lies within the Black Sea basin. The total length of the river is 1,350 km and the basin area is more than 72,000 km². Close to 8 million people live in its basin, more than 5 million live in Ukraine and 2.74 million live in the Republic of Moldova (DC, n.d.b). Furthermore, outside the basin, around 3.5 million people make use of the river's water resources, including the population in the city of Odesa.

The basin supports agriculture, aquaculture, water supply, recreation, hydropower generation, production of building materials, woodworking industry, and mining. Today there are serious ecological challenges within the Dniester River basin associated with the conditions and character of the river's water; pollution from organic, biogenic, hazardous substances, plastic and other household waste; the spread of invasive species; as well as interrelated water quantity and quality issues, such as climate change, floods and inundations, drought and water scarcity. These problems exacerbate economic, social and environmental challenges in Moldova and Ukraine, as well as affect the environmental state of the Black Sea, as outlined in a number of analyses performed in the framework of various projects, which are outlined further below.

Throughout time, the management of the Dniester River has shifted a number of times. During the Soviet Union, it was administered as a united system, and once countries gained their independence it was managed separately by the two riparian countries. Later on, in 1994, the two countries signed a bilateral agreement on the use and protection of water resources in the basin. The agreement had, back then, certain limitations, as it focused mostly on water use in the boundary area and did not consider ecosystems or their biological resources.

Shortly after, aware of the importance of basin-wide management, the two countries requested the OSCE and the United Nations Economic Commission for Europe (UNECE) to facilitate transboundary co-operation in the basin. Since 2004, the OSCE has been engaged in facilitating transboundary

water management in the Dniester River basin. A number of successive projects have been implemented, aimed at addressing flood management, protection of biodiversity, transboundary monitoring, information and data sharing and public awareness raising. In implementing such projects, the OSCE joined efforts with some of its long-term partners, particularly the UNECE and the United Nations Development Programme (UNDP), with a view to provide a tailored response to existing challenges, by making use of the specialized but complementary mandates of the partner agencies.

The results of the joint work have included or contributed to materializing some milestone achievements and a number of important outcomes.

The *Treaty between the Government of the Republic of Moldova and the Cabinet of Ministers of Ukraine on Cooperation in the Field of Protection and Sustainable Development of the Dniester River Basin* was signed in November 2012 (UNECE, 2012). It was ratified in the same year by the Republic of Moldova and in 2017 by Ukraine. In 2015, the two countries endorsed the *Strategic Framework for Adaptation to Climate Change in the Dniester River Basin and its Implementation Plan (OSCE, 2015)*. Alongside the Treaty, the Strategic Framework was a major step forward taken by the two countries as the document was one of the very first such comprehensive approaches to coordinating adaptation measures to climate change at the basin level, underlining, simultaneously, the role of all stakeholders in participating in adaptation measures at all levels. Furthermore, the document identifies the areas and regions within the Dniester River basin with the highest degree of biodiversity and carefully considers the impact of climate change on these areas.

In 2018, the *Commission on Sustainable Use and Protection of the Dniester River Basin* (the Dniester Commission) was established under the Treaty as a body for intergovernmental co-operation between the Republic of Moldova and Ukraine in the area of protection, sustainable use and development of the Dniester River basin (DC, n.d.d). This body provides the necessary platform for the two countries to constructively discuss issues that may be of concern and to timely raise any potential challenges before they turn into points of contention. In this context, it is important to note the Working Group (WG) on Ecosystems and Biodiversity was established under the Dniester Commission (DC, n.d.f). Among others, the WG aims at ensuring co-operation in the field of protection and sustainable use of aquatic ecosystems and bio-

logical resources of the Dniester River basin. Furthermore, it contributes to a joint monitoring of the habitat and status of aquatic biological resources and the development of recommendations aimed at reducing the factors leading to the degradation of biodiversity, wetlands, protected natural areas, and aquatic ecosystems.

In 2021, the two countries signed the *Strategic Action Programme (SAP) for the Dniester River Basin for 2021 - 2035*, as one of the key strategic documents of the work of the Dniester River Basin Commission (DC, n.d.a). The document is based on the findings of the *Transboundary Diagnostic Analysis for the Dniester River Basin* (TDA) and, together with it, they form the basis for the two countries' future management plans (DC, n.d.e). These guiding documents have been developed based on the methodologies of the *Water Framework Directive of the European Parliament (2000/60 / EC)*, in light of the two countries signing the *EU Association Agreement in 2014* (EUR-Lex, 2020; EUR-Lex, 2014; EUR-Lex, 2023). Through their nature, beyond the objective of restoring the river ecosystem and ensuring sustainable development of its natural resources, they support the implementation of international commitments in the area of water management, such as those under the United Nations Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention).

Finally, yet importantly, based on the understanding that water is a strategic resource crucial to local, national and regional security and peace, dedicated attention has been paid by the project to mainstreaming gender considerations in water governance as an additional contributing factor to stability and security by leading to more effective policies and reducing social imbalances and tension. Furthermore, an inclusive approach to water management issues also increases transparency and can contribute to reducing corruption. In this context, the importance of ensuring equal rights and opportunities for men and women in transboundary water resources management at all levels as well as to promoting a gender-balanced approach to water governance/management has been an integral part of the project, throughout its implementation.

These are just some of the most notable results achieved over time that contributed significantly to shaping the joint management of water resources of the Dniester River, and, in a broader form, to enhance trust between the two countries and contribute to good neighbourly relations.

Beyond a political and policy framework, a number of activities of a more practical nature have been implemented aimed at addressing immediate challenges in the basin.

In the most recently completed project funded by the Global Environment Facility (GEF) "Enabling Transboundary Co-operation and Integrated Water Resources Management in the Dniester River Basin" (2017 - 2021) one of the three components aimed at strengthening water resources and biodiversity monitoring and conservation, and information exchange in the Dniester River basin. A number of demonstration projects were implemented within this framework, addressing the issue of degradation of small rivers, loss of biological diversity and invasive species, as follows:

- Ecological restoration of the transboundary river Yahorlyk (the Dniester basin);
- Improving knowledge and improving bilateral co-operation on fish in the Lower Dniester.

Supporting nature-based solutions:
the ecological restoration of the small transboundary Yahorlyk River

Further to the more "traditional" understanding that rivers provide water for domestic supplies, agriculture/irrigation, power generation and industry, one significant aspect, often overlooked, is that rivers provide important benefits in terms of ecosystem goods and services. According to the Intergovernmental Panel on Climate Change (IPCC), ecosystem goods and services include supporting, provisioning, regulating and cultural services (IPCC, 2007). Primary and secondary production, including biodiversity (a resource that is increasingly recognized to sustain many of the goods and services that humans enjoy from ecosystems), are the main supporting services. Products, food, fibre and medical cosmetic products are provisioning services, while the regulating services refer mostly to those services of paramount importance for the human society such as (a) carbon sequestration, (b) climate and water regulation, (c) protection from natural hazards such as floods, avalanches or rock-fall, (d) water and air purification, and (e) disease and pest regulation. Finally, yet equally important, cultural services (and recreational ones) satisfy human spiritual and aesthetic appreciation of ecosystems and of their components (IPCC, 2007).

The international community strives towards achieving good surface and groundwater conditions with a view to enabling rivers to keep providing ecosystem services. This, in turn, contributes to reducing environmental stress on the river basin. Under the conditions of environmental degradation, exacerbated by the effects of a changing climate, the ecosystems and their services can only be preserved if there is an ecologically sound regime for the management of the river, and even more so, of the basin as a whole. This is where the concept of Integrated Water Resources Management (IWRM) comes into play,

> "which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems". (Hassing et al., 2009)

In the Dniester River basin, the sectors of biodiversity and wetlands are some of the most affected by climate change. The decline in biodiversity, the shrinking of the geographical range of native species as a result of the drying of habitats as well as the appearance of invasive species or the reduction of the number of species are just some of the consequences that are already noticeable and that are expected to become even more relevant in the near and long-term future (OSCE, 2015). A decline in the water levels or in the quality of surface and groundwater will only increase the vulnerability of these sectors.

Small rivers are key parts of the river networks. For example, in Ukraine, there are currently 63,000 rivers and 90% of them are small rivers with a basin area of each up to two thousand km². Thousands of such rivers have disappeared in the last 30 years in the country due to various reasons, including insufficient water management, the effects of climate change, etc. Activities such as farming in the riparian zone, overregulation of rivers, and illegal or improper constructions along the riverside are just some of the activities that contribute to river runoff reduction, siltation and overall deterioration of the water resources. In the long run, this leads to the river dying off and, thus, to the discontinuation of the many benefits brought by ecosystems goods and services.

The Yahorlyk River is one of the small transboundary rivers and the left tributary of the Dniester River that flows through Podilskyi and Oknianskyi District of Odesa Region (Ukraine) and in Transdniestria. It flows into the

Dniester on the territory between the cities of Ribnitsa and Dubosary in Transdniestria. Its total length is 73 km.

The Yahorlyk River suffers from regulated water flow with culverts and unauthorized artificial barriers, water bloom and stench of nutrient-loaded stagnant water, waterlogged pastures and significant reed overgrowth, as well as ploughing and fertilization in the floodplain areas and the riparian protection strips. Achieving the goal of restoring the river flow, improving water quality, and tackling associated challenges linked to the threat multiplier effect of climate change, and the arid conditions in the Odesa Region (where the pilot site is located) was one of the top priorities for the local community.

In the framework of the above-mentioned GEF-funded project "Enabling Transboundary Cooperation and Integrated Water Management in the Dniester River Basin", the issue of disappearing small rivers due to inadequate agricultural practices, climate change, redistribution of the water flow caused by ponds, etc. was addressed. More specifically, in 2021 the ecological restoration of the Yahorlyk River flow was performed. To this end, a range of restoration and channel clearing activities on the Yahorlyk River were performed focused on restoring the hydromorphological characteristics of a section of the Yahorlyk River channel - from the Dolzhanka to Rozivka villages in Ukraine. The overall goal was to improve the water quality of the river, restore meadows, pastures and hayfields and to create better conditions for recreation and improve the area's green tourism potential. To this aim, artificial obstacles, such as embankments, were removed, a culvert in the dam under the roadway was constructed, and the channel was cleared from siltation materials and reed rhizomes. This resulted in revitalizing the flow and improving the water quality in the river, preserving and restoring its biodiversity and eliminating the negative impact of waterlogging and reed overgrowth in the channel and floodplain.

Further to the practical measures, one of the main outputs of the demonstration project was the development of a methodology for the restoration of small rivers that could be replicated in both riparian countries of the Dniester River basin, as well as in other regions. Such materials were aimed at building an understanding of the importance of keeping the natural flow of the small river and preventing further artificial barriers from altering its watercourse and the overall ecosystem. That included information about the importance of restraining from prohibited activities, including expansion of

the arable land at the expense of riparian buffer strips, ploughing, the use of fertilizers, construction works, setting up of garbage dumps, etc.

The demonstration project also had an awareness-raising component, with a number of visibility and information materials being developed and placed on the riverbanks. An outreach activity was conducted in the Dovzhanka village, with representatives from four nearby communities (Dovzhanka, Artyrivka, Rozivka and the neighbouring Malayivtsi villages). The awareness-raising campaigns included also detailed information about the cause-effect mechanisms influencing the water quality and underlined that the responsibility for the river health lies, primarily, in the hands of the local community.

Improving knowledge and bilateral co-operation on fish in the Lower Dniester

Another set of practical activities aimed at contributing to improving ecosystem restoration and halting biodiversity loss referred to changing the attitude and approach of riparian states in the Dniester River basin on fish resources and to establishing co-operation based on the values of biodiversity conservation and long-term sustainable interests of local communities in fisheries resources.

The "*Living Planet Report 2022*" of the Word Wide Fund for Nature sent an alarming signal that "monitored freshwater populations have seen an alarming decline of 83% since 1970, more than any other species groups. Habitat loss and barriers to migration routes account for around half the threats to these populations" (WWF, 2022).

The same trend is noticeable, unfortunately, also in the Lower Dniester. The fish resources degradation has been ongoing in the Lower Dniester due to, at times weak coordination among riparian countries, as well as due to a strong impact of negative factors, including the deterioration of the hydrologic river regime, destruction of spawning grounds and flourishing poaching. During the last 10-15 years alone, five fish species have disappeared from commercial fishing. At the same time, other factors like the impact of amateur fishing remain unclear and further research is required in order to have a comprehensive and well-informed overview of the existing challenges. On the background of the lack of available data on this topic – i.e. up to 50% of the fish species in the Dniester have become rarely recorded in the recent 25 years – the separation of research in fisheries by national borders is an addi-

tional obstacle in the evaluation process and, thus, for any attempts at protection of the resource.

Furthermore, identifying solutions to the above-mentioned challenge can only be completed in relation to a thorough analysis of potential scenarios of spring ecological reproductive release from the Dniester reservoir servicing the Dniester Hydropower Plants based on the hydrological and hydrobiological data. These include analysing various parameters such as flooding of the Dniester Delta floodplain to create and maintain favourable environmental conditions there, as well as flooding of spawning grounds in the Dniester Delta to create breeding conditions for fish. Such an analysis of the goals, limitations and opportunities for optimizing the regime of spring ecological reproductive releases from the Dniester reservoir has been produced in the framework of the project and a set of conclusions and recommendations has been produced (DC, n.d.c).

Each state applies different fisheries policies, which creates further challenges. While certain bans on commercial fisheries have been introduced by countries at some point in time, the respective acts have not been simultaneously supported by all parties involved. Therefore, the expected results could not be obtained. In this respect, the main challenges remain the degradation and the decline of the fish resources as well as the lack of transboundary cooperation on this issue, provoking inefficient management of resources by both countries. Efforts, be it in relation to developing and implementing the necessary legislation or attempts to multiply the fish resources and ensure their protection should be taken by all concerned parties, preferably at the same time.

In the framework of the above-mentioned project, activities were aimed at supporting bilateral meetings and field studies, assessing the impact of amateur fishery on fish resources, as well as at developing and testing a methodology for in-situ reproduction of valuable and endangered species. Without adequate measures, the degradation of fish resources in Dniester would continue to be accentuated, due also to the flourishing of fish-related poaching and related illegal fish markets.

The project facilitated a closer co-operation of Moldovan and Ukrainian fish authorities, academics, fishermen communities and civil society organizations and resulted in a positive effect on shaping and application of the unique river basin policies of the states and restoring fish resources. Further

to contributing to the restoration of ecosystem services, to the extent possible, such activities help to provide initial responses to the challenges dealing with the current ecosystem status and to improve the inter-state co-operation of the riparians, as well as in complying with their international commitments taken through the various Multilateral Environmental Agreements.

Future Outlook

Building on the above-outlined achievements, the OSCE is currently developing a follow-up project aimed at "Advancing transboundary co-operation and Integrated Water Resources Management in the Dniester River basin through implementation of the Strategic Action Programme (SAP)". This project, which, if approved, will be financed again by the Global Environment Facility (GEF) and implemented by the OSCE in co-operation with UNDP and with the support of UNECE, will aim at advancing Integrated Water Resources Management (IWRM) in the Dniester River basin contributing to sustainable development by supporting the implementation of the Strategic Action Programme (SAP) priority actions.

The project, which has been designed to follow the strategic directions of action as identified in the SAP, will also address, among others, issues related to adaptation to climate change and increasing preparedness for and resilience to natural disasters. The objective is to increase the resilience of the water ecosystem, enhance the provision of ecosystem services in spite of the climate change impacts, and reduce flood risk through improved river basin management. Activities will focus on demonstrating how the damage caused by climate change on the sectors of the economy most vulnerable to climate change in the Dniester basin can be reduced.

The project activities will also support the riparian countries in implementing their commitments taken at international level, including the OSCE commitments, as outlined in the above-mentioned MC Decision 3/21 "Strengthening Co-operation to Address the Challenges Caused by Climate Change" which, inter alia, "encourages the participating States to identify, raise awareness of, mitigate and adapt to climate-related challenges and to intensify their dialogue and co-operation in this regard with a view to minimizing the economic, social and environmental impacts of climate change" (OSCE, 2021, p.2).

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Climate Policy in the European Security Context: Implications of the Russian Aggression and Post-War Reconstruction and the Recovery of Ukraine

Nataliya Andrusevych

This article discusses the implications of the Russian aggression for the climate and security policies in Ukraine and regionally. The author argues that building a secure climate-neutral Europe needs new approaches to avoid the creation of security threats in the region while Ukraine's green post-war recovery provides a unique opportunity for building a climate-resilient economy that contributes to European climate resilience and security.

Introduction

The connection between climate change and security has become more urgent and has acquired a new dimension and meaning due to the beginning of the full-scale Russian invasion of Ukraine on 24 February 2022, as it showed the vulnerability of international supply chains. Considerations of climate change challenges in security policy planning are on the agenda of the EU and many countries but viewed inversely (how security issues affect climate policy) needs rethinking and new approaches. The main research question explores the implications of the Russian aggression while addressing climate change in Ukraine from different perspectives (local, regional, national, and global). The article starts with an overview of the impact of the war on the environment and the climate. Then it discusses Ukraine's climate policy before and during the war as well as how citizens see the connection between reconstruction and climate change. It also addresses relevant aspects of international, national, and local levels of planning for the reconstruction of Ukraine. In addition, it highlights some aspects of the global dimension of the impact of climate change on security and the role of Ukraine.

The impact of the war on the environment and the climate

Russia's armed aggression against Ukraine not only takes human lives every day but also destroys energy and transport infrastructure, enterprises, housing and even entire cities. It causes enormous damage to Ukraine's environment and produces emissions of climate-change-relevant greenhouse gases. Currently, it is difficult to estimate the damage inflicted on Ukraine's environment and climate as the war is still ongoing and causes new destruction every day. It should be noted that the environmental and climate effects of the war go far beyond the borders of Ukraine. These effects have transboundary (pollution of water resources, drinking water and air, damage to ecosystems) and often pan-European impacts (Black Sea, emissions of greenhouse gases). As of 7 August 2023, the losses estimated by the State Environmental Inspection of Ukraine amount to 2,080 billion hryvnia (€52 billion) (Ministry of the Environmental Protection and Natural Resources of Ukraine, n.d.). Forests, nature reserves, soils, water resources, flora and fauna have been significantly affected by military actions and led to waste of war, fires, air, water and soil pollution and moreover threatened radiation due to the occupation first of the Chornobyl, and then of the Zaporizhzhia nuclear power plants (NPP).

The war also increases greenhouse gas emissions, which has a significant impact beyond the borders of Ukraine. According to the data of the Initiative for Accounting for Greenhouse Gas Emissions, those emissions amounted to 120 million tons of CO_2 equivalent during the first twelve months of the war. This corresponds to Belgium's total volume of greenhouse gas emissions during this period (de Klerk et al., 2023). Experts estimate the total emissions of greenhouse gases from hostilities at 21.9 million tons of CO_2 eq., the largest share being fuel consumption by Russian (14.1 million tons) and Ukrainian (4.7 million tons) troops. Emissions from fires increased significantly, too: from two million tons in the period of February 2021 - February 2022 to 19.7 million tons. It is worth noting that additionally a large part of greenhouse gas emissions has moved outside Ukraine with millions of Ukrainian refugees abroad, the relocation of production to other European countries and changes in passenger and cargo transport flows in Europe and the rest of the world (de Klerk et al., 2023).

A specific example with vast consequences is the destruction of the Kakhovska hydropower plant (HPP) in June 2023. It demonstrates how military aggression, which causes environmental and climate impacts, becomes also a source of devastating effects on food security, population migration, changes in production chains and the absence of a just transition.

Russia's repeated and often deliberate attacks on water infrastructure have caused enormous damage. More than 11 million Ukrainians – or a quarter of Ukraine's pre-war population – were left without reliable access to clean water. The destruction of the Nova Kakhovka dam worsened an already dire situation. This environmental disaster, caused directly by Russia's unprovoked full-scale invasion, forced thousands of Ukrainians to leave their homes and put many thousands more at risk of disease and starvation (U.S. Mission to the OSCE, 2023). In addition, as a result of the detonation, at least 150 tons of heavy oils leaked into the Dnipro River, with the risk of further leakage of an even larger amount (State Agency of the Water Resource of Ukraine [SAWRU], 2023); more than 80 settlements were in the zone of possible flooding (SAWRU, 2023); 333 species of animals and plants, which have different environmental protection statuses and 25 types of habitats are under threat of destruction (SAWRU, 2023). 14.775 km^3 of fresh water were lost (this is about 70% of the original volume) (SAWRU, 2023), 16,000 residents are immediately at risk of flooding due to damage and destruction (dams), and about 20,000 people needed to be relocated (Matiash, 2023).

Ukraine's climate policy before and after the war

Climate policy and legislation in Ukraine are at the stage of formation. Crucial factors influencing the developments are international climate processes as well as the European Green Deal launched in 2019. Despite the war, climate issues occupy a significant place on the country's political agenda, mainly in relation to post-war Ukraine and obligations in the context of Ukraine's aspired accession to the EU.

Ukraine is an active participant in international climate negotiations and processes, such as the Global Methane Initiative (n.d.), the Declaration on Forests and Land Use (UN Climate Change Conference UK 2021, 2021) and others. The country is also a party to all major international legally binding

agreements, including the UN Framework Convention on Climate Change, the Kyoto Protocol and the Paris Agreement.

According to the updated Nationally Determined Contribution to the Paris Agreement (UNFCCC, 2021), Ukraine aims to reduce greenhouse gas emissions to 35% compared to 1990 and achieve climate neutrality no later than 2060.

The European Green Deal (EGD) (European Commission, 2019), adopted in December 2019, had a significant impact on the development of Ukraine's climate policy. Ukraine's involvement in the EGD and its desire for green transformation and climate neutrality received immediate support after it was adopted. Energy efficiency, the transformation of coal regions, the development of hydrogen energy, industrial alliances and the climate governance architecture have become priorities within this context (Council of the European Union, 2021b). The implementation of the principles and the achievement of the goals of the EGD were also supported through a high-level dialogue (Moving forward together, n.d.).

Another stimulating factor for reforming climate policy and legislation was Ukraine's obligations under the EU-Ukraine Association Agreement and Energy Community Annex XXX to the Association Agreement (EUR-Lex, 2023). It contains the obligation to implement three EU acts in the field of climate change: Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, Regulation 842/2006 on certain fluorinated greenhouse gases, and Regulation 2037/2000 on substances that deplete the ozone layer. For the implementation of the climate component of the Agreement, two laws, "On the principles of monitoring, reporting and verification of greenhouse gas emissions" (Verkhovna Rada of Ukraine, 2019a) and "On the regulation of economic activities with ozone-depleting substances and fluorinated greenhouse gases" (Verkhovna Rada of Ukraine, 2019b), were adopted. According to the Pulse of the Agreement (Cabinet of Ministers of Ukraine, n.d.b), the governmental system for monitoring the level of implementation of European legislation, Ukraine has achieved great progress in the field of environment and climate (80%). Nevertheless, Ukraine received a low score in this field according to a report published by the European Commission in February 2023 (European Commission, 2023a).

Activities under the Energy Community are focused on achieving decarbonisation goals and developing a National Energy and Climate Plan (Energy Community, n.d.). In this regard, Ukraine is currently working on the development of such a plan, which should be adopted by June 2024. In this regard, the role of strategic planning is very important. In 2021, the Strategy for Environmental Security and Adaptation to Climate Change for the period of 2030 was adopted (Cabinet of Ministers of Ukraine, 2021c). Furthermore, climate issues were integrated into the National Economy Strategy until 2030 (Cabinet of Ministers of Ukraine, 2021a), the Energy Strategy (Cabinet of Ministers of Ukraine, 2023) and the State Forest Management Strategy of Ukraine until 2035 (Cabinet of Ministers of Ukraine, 2021b). Since the beginning of the war, however, the issue of climate has been put on halt for a while. However, the planning process of Ukraine's post-war reconstruction (National Council for the Recovery of Ukraine from the War, n.d) and the status as a candidate country of the EU (European Council, 2022) have put the focus on the topic again, requiring giving it additional attention.

Post-war reconstruction and recovery of Ukraine: climate issues

How citizens see the issues of reconstruction and climate change

Despite the war, environmental protection continues to be important for 95% of the Ukrainians. An opinion poll on environmental problems in the context of war shows the citizens' concern about the impact on the environment, especially the mining of territories and the waste of war (debris of buildings, destroyed military equipment). Yet, corruption and the misuse of funds are the biggest concerns. In addition, the vast majority of Ukrainians believe that the reconstruction of cities should first of all ensure safety (in particular, the availability of shelters). This leads to the conclusion that the population's support of a climate policy can be ensured and substantiated only through its positioning within the framework of safety and security considerations.

According to the more detailed results of the above-mentioned all-Ukrainian sociological public opinion poll carried out in January 2023 (Resource & Analysis Centre "Society and Environment", 2023), the main principles of post-war recovery should be a tough fight against corruption when using funds for reconstruction (43.1% of the respondents), "to rebuild better than

it was" (41.6%) and to take into account the opinion of communities and people (41.1%). Reconstruction on green principles is supported by only 25.7% of the Ukrainians. It is interesting that the most frequent combination of the principles of urban reconstruction is "safe" and "energy-efficient and environmental". After all, reconstruction on the basis of energy efficiency and environmental friendliness is the second priority of urban reconstruction (57.7%). 63.5% of the citizens believe that new, but modern, modernised and environmentally friendly facilities should be built instead of the destroyed ones. One out of five believes that instead of old enterprises new promising production sites, which previously did not exist in Ukraine, should be developed. 95.2% of the Ukrainians believe that the restoration of nature is important in the post-war reconstruction of Ukraine. The public opinion poll further highlighted that the main sources of funds for the restoration of nature should be state funds (61.5%), reparations (58.6%) and international aid (53.4%).

According to the polled Ukrainians, the two most important priorities of energy policy are energy independence (54.2%) and affordable prices (54.4%). The lowest priority was given to "reduction of consumption and energy efficiency" (14.6%). This indicates the low awareness of the ways to achieve energy independence and affordability of prices. Moreover, the Ukrainians seem not to see the connection between energy efficiency and reducing dependence on energy imports. Priorities considered to achieve energy independence are to increase production of their own energy resources (64.5%) and green energy (66.7%). These data allow the interpretation that Ukrainians do not consider the environmental friendliness of energy as a priority, and this echoes the answers given regarding energy policy priorities.

Nevertheless, 91.1% of the Ukrainians consider climate change a serious problem. The main conclusion might be that the respondents understand the problem of climate change, do not consider it far-fetched and, apparently, are not sufficiently informed about it. This issue should be distinguished from their assessment of the importance of this problem for Ukraine (only 20.6% single out climate change among the main problems of Ukraine). This may indicate a lack of awareness among Ukrainians about the impact of climate change on their lives and the country as a whole.

Reconstruction and recovery on the local level

Despite the fact that the war has not yet ended, post-war reconstruction and recovery is already underway. It is necessary to ensure the primary needs of communities and people: to repair damaged housing, to restore destroyed infrastructure, and to prepare for power and heat blackouts in the winter due to shelling, etc.

Adaptation to climate change should be of high priority to cities and communities when rebuilding, since adaptation measures are a key element of preventing climate-related conflicts in the future (Council of the European Union, 2021a). There are already several successful examples of green reconstruction or transformation. Often the initiators and implementers are public organisations, local activists, or community leaders.

For example, the non-governmental organisations "Ecoaction" and "Greenpeace", together with their partners, restored the damaged heating system of the local dispensary in the village of Horenka, in the Kyiv region. It was restored in the most ecological way – a soil-water heat pump was installed. In addition, solar panels were put on the roof of the hospital covering 40-60% of its electricity needs (Ryhlitskiy, 2023).

Another good example is the Sumy community, where 300 infrastructure objects, including energy infrastructure, were damaged. Thanks to the support of the NGO "Ecoclub" (Rivne), a solar power plant was installed for the needs of a local hospital. In July 2023, it generated 6,425 kWh of electricity, thanks to which it was possible to save 44,461 hryvnia (1,100 euros) (Ecoclub, 2023).

There are also examples of green recovery and transformation at the policy level. Many communities are currently working on plans to rebuild their communities: some are at the concept level, and some are discussing the first steps with residents. For example, the Makariv community (Kyiv region) developed and approved the Concept of Recovery and Development, which, among other things, takes energy conservation, waste management and landscaping into consideration (Bespalov et al., 2023).

On the eve of Russia's full-scale invasion of Ukraine, the Vinnytsia territorial community declared the Green Deal of Vinnytsia (Vinnytsia City Council, 2022) and adopted an ambitious roadmap for its implementation. This policy continued during the war. This is particularly true in the area of food and industrial policy. Thus, the Programme for the Development of the Agricultural Sector and Ensuring Food Security for 2023-2025 was developed and approved and a number of measures for the development of renewable energy sources, "greening" of industrial parks, etc., were implemented (In Vinnytsia work continues on the implementation of the Green Deal: what was achieved in 2022, 2023).

International and national level of planning for the reconstruction of Ukraine

The post-war reconstruction based on green principles and principles of sustainable development will contribute to the strengthening of the environmental and climate component of the entire process of reconstruction. It will also have a positive impact on the interrelation of climate and environmental protection issues with security issues. The support of international partners in the rebuilding process will contribute to the "greening" of such a reconstruction of Ukraine. One example in this regard is the Lugano Declaration endorsing guiding principles of the recovery process. In particular, sustainable development is defined as one of the principles. It stipulates that…

> "…the recovery process has to rebuild Ukraine in a sustainable manner aligned with the 2030 Agenda for sustainable development and the Paris Agreement, integrating social, economic and environmental dimensions including the green transition." (Ukraine Recovery Conference, 2022)

The 2023 Ukraine Recovery Conference in London emphasized the importance of development and reconstruction through the attraction of private investment. It also addressed security issues, particularly in the context of the green transition. In his congratulatory speech, the President of Ukraine, Volodymyr Zelenskyy, highlighted that "green transformation is one of the key foundations of security... it is green energy that guarantees real energy stability." (President of the Ukraine, 2023, para.27)

In April 2022, by the decree of the President of Ukraine, the National Council for the Recovery of Ukraine from the Consequences of the War was es-

tablished (President of Ukraine, 2022). The main tasks of the Council included the development of a plan of measures for post-war recovery and development, determining the directions of priority reforms and preparing strategic initiatives. As a matter of fact, in 2022 the National Council (in the format of 24 working groups) put forward a draft plan of measures for Ukraine's post-war reconstruction and development (Cabinet of Ministers of Ukraine, n.d.a). Currently, the main results are the materials put forward by the working groups, as the document itself has not yet been formally approved.

Climate issues were considered in this process in the context of environmental security. The main focus was placed on the development of a climate policy and the adoption of a climate legislation, including financial incentives and instruments. In part, climate issues were integrated into other sectors of the draft plan, such as agriculture policy, energy, and regional development. Security issues are mainstreamed into almost all sections of the draft plan, but the link between climate and security has practically not been made, partly only in the context of energy security. Nevertheless, there is an understanding that new challenges should be integrated in the strategic planning. In particular, this concerns security issues, risks associated with the destruction of energy and other critical infrastructure as well as consequences to the environment and climate caused by Russia's armed aggression. For example, the State Strategy for Regional Development until 2027 is revised within this context (Ministry for Restoration of Ukraine, 2023).

The support of green reconstruction by international partners through financial instruments is very important. In particular, the recently announced Ukraine Facility (European Commission, 2023b) instrument establishes a vision for the green transition. Among its goals, it defines overcoming the social, economic and environmental impacts of the war. The Ukraine Facility aims at promoting social, economic and environmental sustainability and at contributing to the reconstruction and modernisation of the country. Activities to be financed under the new instrument should be the basis of climate change mitigation and adaptation, environmental protection, human rights, and gender equality. The Ukraine Facility must not support activities or measures that are incompatible with the National Energy and Climate Plan (if any), the NPP of Ukraine as well as investments in fossil fuels. It will not support projects that cause significant damage to the environment or climate.

Climate and security nexus

The global dimension of the impact of climate change on security and the role of Ukraine

Since climate change and environmental degradation know no bounds, the risks arising from them can also go far beyond national borders and affect entire regions, or even be global in nature. Global efforts to mitigate and adapt to climate change will have a significant impact on countries whose economies depend on fossil fuels. Climate change and environmental degradation are recognised as risks to international peace and security, and new geopolitical challenges deriving from climate change and the green transition can exert additional pressure on global, regional and local security (European External Action Service, 2021).

The Russian aggression against Ukraine has shown that the issue of security should be considered beyond its traditional understanding. Security also has energy, economic, food, and climate dimensions. In the field of defence, the EU actively promotes preparing the armed forces for climate change, implementing decarbonisation strategies in the armed forces and taking into account climate issues, reducing the carbon footprint (Council of the European Union, 2020). These are important but insufficient actions to overcome modern challenges. These efforts, in fact, primarily remain part of the climate policy but not the security policy of the EU and its Member States.

In the context of Russia's armed aggression, it is important to ensure the integration of the relationship between climate and security into the policies and instruments of both the EU and individual countries. The new German Security Strategy is a good example of such an integration (Federal Foreign Office, 2023) (though it is based on a traditional climate crisis approach where the primary source of concern is the impact of climate change but not the security implications stemming from the implementation of the climate policies). The issue of taking climate factors into account is important not only in the context of conflict prevention but also for responding to existing crises and conflicts, understanding the sources of possible conflicts in the future and their prevention.

Globally, water and food availability as well as climate change have a growing impact on security, while the dependence on fossil fuels and the supply of renewable energy sources present more strategic risks and challenges (Coun-

cil of the European Union, 2020). The issue of the green transition has and will have an impact in the future on those countries whose economy depends on fossil fuels, especially from Russia. If these countries do not find climate-neutral alternatives for such dependences, this will have a negative socio-economic impact. For example, countries with a high share of oil or gas export income in the public budget will inevitably face gaps in social-expenditures, including pensions and health. Similarly, countries relying on the export of carbon-intensive products to the EU will either need to invest into decarbonised production or find their way into other highly competitive markets.

The development of a new economic paradigm in accordance with the principles of the European Green Deal involves the gradual phasing-out of fossil fuels, the need for access to critical materials and resources, the creation and scaling of new production chains, etc. This should not create new types of dependences, which are a source of conflicts, contradictions and inequalities. It should be based on the principle of cooperation, maximum interaction and diversification of new chains of added value, sources of critical materials, etc. Several emerging and developing countries have raised concerns about some of the EU's recent green initiatives, as those could turn into barriers to their development (European Commission, 2023c). In other words, trying to apply (copy) the principles and approaches of the existing security system to the new climate-neutral economy will lead to the creation (copying) of security threats in the region similar to the existing ones.

Ukraine's security issues are closely related to its participation in the EU market, especially in the context of the European Green Deal, which includes joining green alliances, green hydrogen production, and ensuring food security. The presence of critical materials necessary for the green transition in Ukraine should become a factor in the acceleration of post-war economic development. Ukraine cannot be considered only as a supplier of necessary resources, which may turn it into an object of confrontation between developed states in the future.

It is also important that the climate-security nexus is human rights-based, gender- and age-specific, and ensures that policies and initiatives addressing the climate change-security nexus are also taken into account. It is necessary to factor in the vulnerability of women to climate issues, in particular in the context of their forced migration due to war. Nevertheless, the special lead-

ership role associated with increasing responsibility for their own family, children and professional activities at home should be mentioned. Therefore, including a systematic gender analysis is important. Such an analysis aims not only at understanding vulnerabilities, but also at identifying opportunities for leadership and involving women in the decision-making process (Council of the European Union, 2021a).

Conclusions

The Russian aggression against Ukraine has deepened the understanding in general that the security of the European continent must be considered not only in the military and defence context but also in the energy, climate and food contexts.

In view of the main implications, the following conclusions can be made for the future of the climate and security policies in Ukraine and regionally:

1. The climate impact of Russia's armed aggression against Ukraine goes far beyond Ukraine's borders, and the interrelation between climate issues and security has taken on a new dimension and requires the search for new approaches. A series of environmental consequences has demonstrated the close relationship between security, climate and migration issues.
2. The post-war reconstruction of Ukraine and the need to implement the EU acquis in the field of climate change gives Ukraine a unique opportunity to develop a high-quality climate policy: it also provides the chance to rebuild the country on green principles. Increasing attention to security issues means that questions of climate and environmental security are becoming as important as questions of energy and food security. Ukraine's potential role in the future as a major supplier of clean electricity and food, as well as a partner in the development of green hydrogen and the critical feedstock base for the green transition, makes a close integration of Ukraine with the EU desirable.
3. The European security policy and system should consider the following: building a carbon-neutral economy on the continent must not ignore the need to avoid future contradictions and conflicts related to access to the resources and technologies needed for the green transition and climate neutrality.

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Central Asia: Challenges and Opportunities by Way of the Middle Corridor

Stefanie Wesch

Climate impacts in Central Asia will be unevenly distributed, potentially leading to competition over scarce resources such as water and land. Yield gains are expected in parts of Kazakhstan, while Tajikistan may see decreases. Hydropower aspirations may be dampened due to recurring droughts. The Afghan Qosh Tepa canal project could decrease water availability in downstream Uzbekistan and Turkmenistan but benefit Afghanistan, which may exacerbate tensions within the region. Women have a crucial role in fostering social cohesion through climate adaptation efforts but must be brought into formalized decision-making processes.

More than Just Neighbours of Afghanistan and Former Soviet Republics: An Introduction to Central Asia

The Russian invasion of Ukraine in February of 2022 changed geopolitical perceptions a lot and has put a spotlight on many of the former Soviet Republics, chiefly among the states comprising Central Asia. Located at the strategic gateway between Europe and the big producers as well as buyers' markets of South and East Asia, lay Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan and Turkmenistan. While not representing a cultural and historical monolith, all five countries have a shared cultural as well as political history, given that they all formed part of the Soviet Union from 1918 to 1991. To this day, ties with Russia continue to be strong. Russia is a major trading partner, an ally in the Collective Security Treaty Organization (CSTO) and home to millions of Central Asia migrant labourers, who regularly send remittances to their home countries. For Tajikistan, this has provided 25% of GDP in the year 2020 (GIZ, 2022). In recent years the region has also started to experience increasing social unrest on behalf of the population. Triggers have been of an economic nature as well as perceived ethnic marginalization/ loss of autonomy on behalf of minorities. Protests have been met with sometimes harsh security force response and human rights organizations including different UN bodies have been sounding the alarm about imprison-

ment and mistreatment/torture of protesters in the region (Amnesty International, 2022; United Nations of the High Commissioner on Human Rights, 2022; Human Rights Watch, 2022).

Historically, Central Asia has been and continues to be strongly reliant upon agricultural production, which makes up a major component of GDP and provides jobs for roughly 45% and 25% of the population of Tajikistan and Uzbekistan respectively (USAID, 2021). In addition, many more households engage in agricultural cultivation in their private gardens and fields to supplement their income. Simultaneously, the relations between these countries are dominated by a significant upstream-downstream topography and shared water resources in a region that is mainly located within semi-arid and arid climatic zones, with aridity projected to expand as climate impacts take their course (Wang & Zhang, 2020). Against this backdrop, the countries' respective economies employ vastly different and, at times, opposing strategies to generate income. Unlike other regions, Central Asian river flow is mainly fed by snow and glacial melt. On the one hand, the overwhelmingly mountainous upstream countries Tajikistan and Kyrgyzstan rely heavily on hydropower production to cover their energy needs as well as for export purposes. For this purpose, water reservoirs need to be filled in spring and summer with snow and glacial melt. On the other hand, the downstream countries Turkmenistan, Uzbekistan and Kazakhstan mainly have been focusing on agricultural production, most notably highly water-intensive cotton. Hence, they rely on snow and glacial melt for cultivation and irrigation.

For this purpose, a vast network of irrigation canals has been built and successfully expanded upon during the Soviet era. Indeed, so successful that it has resulted in a general overuse of the regional water resources, with the most notorious example being the remnants of the formerly great Aral Sea. Where once there were large harbours and fishing towns, there now lie desert and rusty old ships. Little remains of the lake, only a 10^{th} of its size compared to the year 1960. This has brought about losses in fishing livelihoods as well as increases in sandstorms due to the large parts of the exposed seabed, resulting in adverse pulmonary health consequences (Wang et al., 2022).

There are two additional complicating factors to the overuse of water resources within this region. One is the outdated and leaky Soviet irrigation infrastructure that ensures that much of the water that is channelled towards

agricultural fields, does not even make it there, but instead is lost en route. The other major challenge, of course, is climate change. The geopolitical changes since independence from the Soviet Union have led to a stark drop in cooperation. An atmosphere of distrust, brought about by internal as well as external governance factors, had resulted in perpetual zero-sum game attitudes in the 1990s and 2000s, and it had led the path away from cooperation (Pohl et al., 2017). However, despite some outlier incidents, recent developments give rise to cautious hope with respect to trust building efforts. The topic of climate change is generally seen as a less sensitive issue, which nevertheless poses a threat to the entire region and beyond. Hence, it serves as a suitable entry point for increased cooperation and integrated action. The challenges in Central Asia are multifaceted and greater geopolitical developments of the last two years, such as the Russian War of Aggression on Ukraine, have shifted Central Asia into focus. Will the climate crisis exacerbate prospects for stability in the region?

Where Are We At?
Observed Climate Impacts in Central Asia

When addressing the climate crisis, often the focus is on future impacts, as projections typically centre around the years 2050, 2080 and 2100. However, in many of the world's regions, we can already observe impacts on the ground. Emerging attribution science is helping to make these already observed impacts of anthropogenic, hence human-made, extreme weather events more visible and provides us with indications of how much more likely specific climatological events have become due to human-environmental interactions. With regard to the availability of observed data, the observation network in the region can be scarce, depending on the particular subregion. In addition, the data is not always reliable and data sharing between states and authorities can be quite political and interlaced with mistrust (Finaev et al., 2016). However, Haag et al. (2021) note that beyond the technical data, regional communities, particularly those engaging in agricultural cultivation or agro-pastoralism tend to have intricate knowledge of local weather patterns and climate. Where needed this can serve to bolster unreliable data or be used in lieu of meteorological station data, where it is lacking entirely. While impacts are distributed unevenly throughout the region, for the Central Asian region there is already an increase in aridity levels, particularly in mountain landscapes, which already has adverse impacts on the via-

bility of certain shrub species (Costello et al., 2022). Recurring drought in large areas of east-central Asia is leading to lower humidity, temperature increases, as well as drops in soil moisture (Birkmann et al., 2022). Water scarcity represents a formidable challenge for the region, which is particularly true for Turkmenistan and Uzbekistan. Here withdrawal of water is already equal to water availability, hence not leaving much wiggle room for climate impacts to put further stress on the vital resource (Shaw et al., 2022). Risks related to desertification, wildfires, and dust storms have increased as a result of higher temperatures and a decrease in precipitation (Shaw et al., 2022).

While the Aral Sea Disaster is mainly a product of unsustainable cultivation practices related to water-intensive cotton production, increases in water scarcity will put additional stress on an ecosystem already past its breaking point. The long-forgotten dumping of chemicals into the Aral Sea is now coming back to haunt the local as well as more removed populations. As dust storms are increasing in the region, due to increased aridity, sand, salts and long-forgotten chemicals are contributing to pulmonary illnesses and other adverse health risks currently being studied (Wang et al., 2022).

Impacts that are central in debates around climate change in Central Asia are those connected to the deteriorating constitution of the many regional glaciers in the Pamirs and Tian Shan mountain ranges, the water towers of Central Asia. Increases in air temperature influence the hydrological cycle. This in turn influences water availability for the upstream and even more acutely for the downstream population. Over the period between 1970 to 2009, it was determined that the volume of snow in the Pamir Mountains decreased by 0.74% compared to the period between 1927 to 1969 (Finaev et al., 2016). Between 1986 and 2008, Zhou, Aizen, and Aizen (2017) quantified a significant decrease in the number of snow on ground days for all of Central Asia. A study of (Haag et al., 2021) observed for the period between 2001 to 2018 that there is an increasing trend in the timing of snow onset and a decreasing trend in the timing of snow offset, resulting in a shortened snow season for two observed Tajik villages (Savnob and Roshorv) in the Pamir Mountains. Furthermore, Finaev et al. (2016) determined a reduction in winter snow stocks by 2.5% due to a reduction of the entire snow area between 1970 to 2009 compared to 1927 to 1969. Precipitation trends are, in general, less clear than those in temperature and certainly exhibit greater variance between Central Asian States and even within them. In addition, altitude and season-

ality play a crucial role in determining changes in temperature as well as precipitation. (Haag et al., 2021). Considering that Central Asia has much diversity with respect to topography, more high-resolution sub-regional studies are needed to shed light on this notoriously understudied region (Vakulchuk et al., 2023). Studies show that in the Pamirs, there is an overall trend of glacial reduction (Finaev et al., 2016). However, there are sub-regional anomalies. Hence, studies concerning mass change of glaciers in the Pamirs have been inconsistent, increasing the uncertainty about the understanding of glacial changes in the region (Barandun et al., 2020). While the early seasonal river discharge is mostly fed by winter snowfall, by July to September glaciers and permafrost release most of their meltwater and feed into river discharge. However, the melting of glaciers and permafrost does not only affect water availability within this region but indeed leads to many other natural disaster risks associated with high-mountain landscapes, e.g. glacial lake outbursts. Snowfall swiftly followed by temperature around the melting point can lead to increases in avalanches, flash floods, landslides, and other disasters in the Tian Shan ranges as well as the Pamirs (Shaw et al., 2022). The same is true for fast glacial melt and thawing of permafrost. The likelihood of heatwaves, droughts, delays and weakening of the monsoon circulation, floods, and accelerated glacial melting in Central Asia increases due to already observed temperature rises (Shaw et al., 2022). There is a plethora of observed climate impacts in this region, but what does this mean within the context of geopolitical developments human security, infrastructure and gender relations?

Water scarcity and Water Management as a Source for Unrest and Violence in Central Asia

On April 28, 2021, a conflict escalated on the border between Kyrgyzstan and Tajikistan around the Tajik exclave within Kyrgyzstan, Vorukh, which formally lasted 3 days (Imanaliyeva et al., 2021). The clashes were caused, inter alia, by the unclear delimitation of borders and the claims by both sides to the scarce water resources (Gotev, 2021). According to the reports, the installation of surveillance cameras at a water distribution point near the village of Kök-Tash triggered the conflict (Radio Free Europe, 2021; Pannier, 2021). Initially, the fights on both sides were fought with fists and stones, however, a new level of escalation was quickly reached and both sides made use of heavy weapons (Reuters, 2021). It is estimated that 10,000 people were evacuated in the border region, and over 50 people died in total (BBC News,

2021). On May 3, both countries executed the withdrawal of their troops from the borders, ending the largest military confrontation in the region since the breakup of the Soviet Union in 1991 (Pannier, 2021).

Conflicts like this one, some violent and some not, have occurred again and again in the region. Tajikistan and Kyrgyzstan seem involved often, but also Kazakhstan, Uzbekistan and Turkmenistan have had their share of outbreaks or at least close calls. Since independence of all five post-Soviet Republics, water and energy have become increasingly sensitive topics. All five states have been involved in some form of latent conflicts and outbreaks of violence with their neighbours. Violence between communities as well as military clashes have been particularly salient between Kyrgyzstan and Tajikistan. Both states are struggling economically, with a large number of the population of both states engaging in labour migration to Russia (Rocheva & Varshaver, 2017). While strides have been made on the Kyrgyz side to move towards democratization, Tajikistan is firmly under autocratic rule. In the past 30 years since independence, tensions have occurred repeatedly along the Kyrgyz-Tajik border. The 970-kilometer-long border is marked by exclaves and unclear borders, which represents a major challenge and is underlying the repeated outbreaks of violence between the two states (Radio Free Europe, 2021; Pannier, 2021). The demarcation process is complicated by other factors such as "smuggling, drug trafficking, as well as the intrusion of criminal groups and violent extremist organizations" (Arynova & Schmeier, 2021). While territorial disputes are underlying the tensions, water and natural resource quarrels as well as disagreements over often inefficient water infrastructure and governance missteps are complicating factors (Arynova & Schmeier, 2021). Shared water has become a trigger and threat multiplier in the conflicts at the Tajik-Kyrgyz border. While the problems related to water scarcity are still largely human-made and indeed governance-related, the climate impacts that are starting to be observed and projected future impacts will undoubtedly serve as conflict multipliers in this already eventful border region. The winter season will also be disproportionately affected, higher temperature changes are expected during winter months. (Lioubimtseva & Henebry, 2009). In line with these studies, projections indicate possible changes in snowpack and seasonal shifts of spring melt as a result of warming trends in upstream regions of Central Asia (IPCC, 2022). This will not only produce adverse impacts on ecosystem services and economic development

but can severely impact intercommunal relations of different ethnic groups residing in those more volatile border regions (Kurmanalieva, 2018).

Indeed, even beyond outright outbreaks of violence, the lack of transboundary water cooperation has costs associated with it. In a 2016 study, the World Bank assessed the cost of good versus bad water governance and found that it was 20% of GDP for Central Asia by 2050. However, this does not include cascading social costs, hence underestimating the actual cost (Pohl et al., 2017).

Energy Security for Whom?
Energy production in light of Geopolitics and the Climate Crisis

The energy sector is another area where monetary losses caused by inadequate governance and climate change, could be detrimental. Energy production and consumption are intricately linked to emissions and can thus be a powerful avenue for mitigation. Since the start of the Russian war of aggression against Ukraine, the European Union has certainly realized the level of vulnerability they have to energy security. The utilization of gas supplies as a bargaining chip by Russia has made it painfully clear that energy supplies need to be diversified, while also being green(-er). The geopolitical shifts brought about by this major war in Europe have put a spotlight on Central Asia. Since then, the European Union, the United States as well as other bi- and multilateral cooperation with the region has intensified.

Looking at regional energy consumption, the record is quite mixed. While the upstream countries generally take advantage of the regional water resources to produce hydropower, the downstream countries still have a high reliance on coal, oil and gas for energy production. There have been heavy investments into the relevant infrastructure, including power grids, yet power shortages are common. This can have detrimental impacts on the affected populations, including life-threatening emergencies. Reasons for such disruptions in power supply are multifaceted. For upstream countries Kyrgyzstan and Tajikistan, which are highly dependent on hydropower, the ever-increasing number of droughts has led to water reservoirs that cannot be filled. Without sufficient water levels, there is no electricity. Projections for the region indicate above global average warming in the future due to climate change, suggesting temperature changes of about 2 to 7°C when comparing

mean temperatures from 2071-2100 and 1971-2000 with hot spots of warming in mountainous regions such as the Pamir Mountains (Mannig et al., 2013). Water scarcity will increase due to a significant rise in temperatures across Central Asia and the associated increase in evapotranspiration, even if mean precipitation does not decline. The number of extremely hot will likely increase significantly, with detrimental impacts on labour and the economy as a whole. (Shaw et al., 2022). However, Tajikistan is home to some of the largest hydropower plants and is looking to further expand its hydropower production as it is taking advantage of only 4% of its hydropower potential, instead of the 527 terawatt-hours (TWh) that are estimated to be the maximum the country could produce (IEA, 2022). The climate crisis could have dire consequences for hydropower production in the region, with negative feedback loops being a potential outcome. Further complicating matters, the energy infrastructure in the region is outdated and in desperate need of restoration/ reconstruction. Both are crucial factors that require further consideration by funders and implementing states.

While the Central Asian governments are keenly aware of the necessity to phase out fossil fuels, especially within the energy sector, the reliance on oil, coal and gas continues to be high. There are many reasons why this is the case and why it will be a formidable challenge to move into this direction. Similar to other coal mining regions, there are entire regions and their respective communities that are built around the coal mining industry (Kizeková, 2022). Hence, the structural changes that need to occur are not only related to putting novel infrastructure in place, but indeed it will take concerted efforts to address the socio-economic needs of the affected communities. This may include re-training workers in new professions, transforming former coal mining landscapes into environments that restore quality of life and potentially even supported resettlements for very remote communities, where this industry cannot simply be replaced. This process can be quite disruptive and stir up additional grievances within the respective communities (Pai et al., 2021). With the governments of Uzbekistan, as well as Kazakhstan and Tajikistan, already having struggled with local social movements over the last two years, governments may consider wide-reaching structural changes more carefully (Amnesty International, 2022; United Nations of the High Commissioner on Human Rights, 2022; Human Rights Watch, 2022). After violent clashes between protesters and state-based security forces, social cohesion and relations between government and the public

have suffered greatly and trust in governmental institutions has taken a big hit. Another complicating factor with regards to a social-ecological transformation in Central Asia is the tight personal relations between the fossil fuel industry and government officials. Challenging the business-as-usual model through wide-reaching structural changes also threatens profits. It is to be expected that the heads of affected industries are likely to lobby their network in positions of regulatory power. A promising avenue could be foreign investment. The EU as well as particular EU countries, such as Germany, are trying to intensify cooperative mechanisms with Central Asian partners with respect to energy, in particular Green Hydrogen production. This may be the way to transform coal communities, without the socio-economic ripple effects that a simple discontinuation might have. How these partnerships will be filled with life and concrete measures is still unclear, with joint statement remaining vague and aspirational in nature. However, well thought out, it could further cement EU-Central Asia relations and build mutual trust by providing long-term win-win engagement in the region. In addition, EU support for building infrastructure to support the completion of the Middle Corridor, a supply chain route that circumvents Russian territory via the Caspian Sea, will open up opportunities for further exchange.

The Power of Gender: How Inclusivity Can Provide Appropriate Measures for Dealing with the Climate Crisis

Understanding the gender dimensions of the climate-security nexus in Central Asia is essential for a comprehensive analysis of the region's challenges. Gender considerations intersect with the climate crisis and security in various ways. However, the approach gender is often addressed in the political, journalistic and academic spheres is through the narrative of vulnerability only. While this is of course the case to some extent, there is much more to gender dimensions than just victimhood. Women are indeed more likely to be engaged in agriculture, a sector that is particularly vulnerable to climate impacts (Thornton et al., 2014). The summers in most of Central Asia are already marked by extreme heat. According to climate projections, the climate crisis is set to increase the occurrence of heatwaves as well as the number of very hot days (Shaw et al., 2022). This will result in detrimental health impacts for those working in fields such as agriculture and construction as well as the sick and the elderly (ILO, 2019). When resources are scarce, women's workload typically increases. Given that they are often the primary caregivers for

children and elderly, they are particularly vulnerable to natural disasters. Natural disasters such as large rock falls, associated with glacier and permafrost degradation are predicted to increase in frequency and magnitude as global temperatures rise, gravely affecting the human security of women, the elderly, people with disabilities and children (Barandun et al., 2020). Access to resources represents another crucial factor that often contributes to the vulnerability and marginalization of women. In Central Asian societies, women's access to land and other vital resources, natural as well as monetary, remains limited.

Central Asian out-migration is highly gendered. Statistics provided by the Russian Federation for the year 2016, which is representative for other years, indicate that only 16% of Tajik migrants in Russia were female, while 18% of Uzbek migrants were counted as female. Kyrgyzstan however exhibits a higher rate of 38%. Women mostly stay behind in Central Asia because of gendered norms. Research for the context of Central Asia is still sparse, but in their 2017 study, Rocheva and Varshaver elaborate on the differing social pressure that leads to gendered migration within the regional context:

> "The social legitimacy of female migration and, more broadly, perceptions of female migration are closely connected with concepts of femininity and masculinity in the sending societies. Migration in Central Asia is tied to fulfilling a man's ability to perform the roles of a good son, husband, father and neighbour even though it is fraught with existential and emotional risks, whereas staying behind can challenge his masculinity." (Rocheva & Varshaver, 2017, p.95)

Most often, the women who stay behind, work in agriculture. Hence projections are particularly worrying in light of highly gendered migration in Tajikistan and Uzbekistan and climate projections for the South of Central Asia. The agricultural sector serves as a poignant example, with positive income gains being projected for large-scale commercial farms in northern regions of Kazakhstan and adverse impacts for the economically worse-off states to the South, especially for small-scale farms in arid zones such as Tajikistan (Shaw et al., 2022).

While migration and displacement can further erode women's resilience, they can also disrupt traditional gender roles and power dynamics within households and communities. Women may become the primary breadwinners and

gain more freedom with regard to day-to-day household decision-making processes. Indeed, due to their involvement in the agricultural sector, they often possess unique traditional knowledge, which can be beneficial for designing climate-related resilience and coping strategies for their households as well as communities.

Despite their knowledge being an asset to their communities, women tend to be noticeably absent from the decision-making table. Decisions with regards to the vital topic of water governance as well as climate adaptation and connected disaster risk reduction and management, are often taken without harnessing the expertise of this knowledgeable and large part of the population. Hence, female perspectives are lacking entirely in the design of resilience-enhancing strategies and governmental policies. However, there are some promising examples of active inclusion of women in Central Asia. The example of Uguloy Abdullaeva serves as a lighthouse example of the agency of women and what they can accomplish for their communities when included in decision-making bodies. Furthermore, it serves as an example of how men can act as allies to support inclusivity within their respective communities. Uguloy was nominated by the men of her community to form a local association of water users and become chair of said organization. Feeling the responsibility, she went to work immediately and started collecting money from the community. She was able to collect 1811 Somoni or about 155 €. She used these funds to travel to Dushanbe to engage in fundraising for her organization. She was able to raise significant funding from international donors for her community. With said funds, she was able to finance an excavator, build an office, as well as treat the community's water. The organization was able to install pipes and drainage and build in controls to monitor and manage water distribution. In addition, she received relevant trainings through international cooperation agencies, which she was able to share and thus multiply within her village (UN Women, 2020). While Ugoly's story is a tale of success and women's agency, it is far away from being the norm. As Zhyldyz Ysmanova, a gender expert at the Central Asian Alliance on Water puts it:

> "We observed that when women are board members of these associations they are more efficient because women are the main water users. For example, when men only are board members, they decide on water supply for four consecutive hours a day and do not take into account the needs of the house-

> hold. Overall, I can say that women are much more informed on water needs and they know exactly where the next pipe should be built to ease the burden on them." (Delgado & Mukhamedova, 2020, p.7)

Intensified efforts in this direction are needed to not only produce isolated best practice examples but to foster an entire network of such female activists and experts. As a specialized network, women will be in a better position to demand a seat at the decision-making tables and have more clout with respect to influencing and crafting climate-related policies that serve the entire population.

Complicating Matters: The Afghan Qosh Tepa Canal

Bordering Tajikistan, Uzbekistan and Turkmenistan, Afghanistan has for decades been the fragile neighbour to the South. Fears of spillover effects of extremist or jihadist ideology from Afghanistan have guided the strong pushback regarding security policy of particularly the Uzbek and Tajik governments. However, since the Taliban takeover of the Afghan government, diplomatic relations have been slowly re-established between the Taliban-led government and the Central Asian Republics. However, news broke in 2022 regarding the initiation of construction of the Qosh Tepa Canal on behalf of the Afghan government. In efforts to restore infrastructure, intensify agricultural production and bolster economic development, the 285 km canal will redirect water from the Amu Darya river, which downstream Uzbekistan and Turkmenistan largely depend on for water-intensive cotton production, along with the production of other crops. The project is planned across three construction phases over five years and will allow Afghanistan to divert up to a staggering 25% of current Amu Darya flow will be redirected towards Afghanistan through the Qosh Tepa canal (Gafurov et al., 2023). The canal was first envisioned some 50 years ago. While this is causing much concern within the neighbourhood, the direct neighbours have not put into question the right of Afghanistan to build it and withdraw its equitable share. However, causing concern is not only the mere fact that the canal is being built but indeed the quality of the construction. As the project is being undertaken right now, the canal will lose much water en route due to the inefficiency of the construction itself. Hence, Uzbekistan has proposed technical assistance for the project in order to support the efficiency of the redirected water resources (OpinioJuris, 2022). No wonder, Uzbekistan is looking to get in-

volved. The potential downstream impacts are grave. Uzbekistan is highly dependent on irrigation systems for agricultural production, a sector that accounts for 25% of GDP. In Uzbekistan, cotton and wheat take up the largest cropping area. The country has made great strides in terms of economic development and its population has been growing steadily, leading to an increase in water demand. This already meets a decreasing water supply due to old irrigation infrastructure and climate change (Garfurov et al., 2023). Increases in drought occurrence as well as increases in evapo-transpiration due to higher temperatures have adverse consequences for the availability of water already. For the foreseeable future projections show that water stress is likely to increase further due to increases in drought and decreasing precipitation trends in parts of Central Asia, which are likely to add to the incidence as well as severity of droughts (Shaw et al., 2022). The massive water withdrawal could lead to an overall decline in suitable cropland of up to 18.9% in Uzbekistan alone. Cascading risks of losses of crops or cropland include food insecurity and rising food prices within the entire region and beyond (Garfurov et al., 2023). This of course can lead to internal instability and civil unrest, as we have seen in the Arab Spring and the genesis of the war in Syria. The Qosh Tepa Canal is yet one more element in a perfect storm for instability in a region that has generally managed to remain stable, despite the decade-long instability to the South of its borders.

Ways Forward: How to Mitigate the Worst and Peacefully Adapt to the Inevitable

The climate-security nexus in Central Asia is a complex and evolving challenge that requires a multifaceted and cooperative approach. Climate risks are intricately intertwined with already existing, underlying challenges in the region. The upstream-downstream topography determines the opposing economic interests, with transboundary waters being central for both, hydropower production as well as agriculture.

It is important to note that as of yet, it is unclear whether the international community will manage to comply with the warming and thus emissions targets set at the Paris Conference of Parties (COP), the United Nations climate conference. The climate research community has worked out several emissions and socio-economic pathways scenarios, but it is not yet clear which path will be taken. This means that projections can indeed go many different ways. However, general trends with varying severity can be identified already.

As climate impacts are beginning to unfold across Central Asia, projections indicate significant variation across the region. Indeed, climatic trends will be distributed unevenly, not only between states, but across sub-regions, altitude, and seasonality (Shaw et al., 2022). Increases in drought occurrence, heatwaves, and rainstorms can cause widespread crop failure (Shaw et al., 2022) Moreover, glaciers located below 3200 m are projected to decrease in size (Finaev et al., 2016).

The generally uneven distribution of impacts within the region with its distinct implications for agriculture, ecosystems, and human well-being, may lead to increased resentment between the five post-Soviet republics and increased tensions, particularly in the not clearly demarcated border regions. Remnants of distrust between governments are at times stifling efforts for increased cooperation. This is particularly true with regard to climatic risks. Hence, trust-building measures will be vital as the region moves forward in addressing the climate impacts that are already visible as well as those to come.

Disagreements over access to water, exacerbated by recurring droughts, can be the trigger that ignites violence and instability within and between countries, as is already the case on a lower level today. While all of this may sound very gloomy, it shouldn't paralyze us into inaction. Two vital toolboxes promise relief and potential opportunities through co-benefits. Mitigation and adaptation efforts can help to prevent some of the worst climate impacts as well as help us manage those that we are no longer able to stop. Designing Disaster Risk Reduction and Management measures and protocols will be vital to protect those that are most vulnerable. Existing multilateral institutions, such as the Centre for Emergency Situations and Disaster Risk Reduction, need to be supported and strengthened. The active involvement of women in this process will help to ensure not only representation and equality but also measures that take into account the needs of all household members, regardless of how strong or weak they are. (Kogutenko et al., 2022). Along the same line, water governance should increasingly include women on all levels of decision-making, from communal to state-level. To build up trust between Central Asian States, topics that are less political in the region, yet concern all, can be used as entry points for improved cooperation. While water is still a sensitive topic, the climate crisis can serve as an entry point for dialogue. This is already being done through science diplomacy and the facilitation of high-level dialogue between heads of state. The recent presen-

tation of a joint Regional Strategy for Adaptation to Climate Change at COP28 in Dubai is a case in point with respect to positive developments and increased cooperation (CAREC, 2023). Moreover, efforts such as the establishment of the Central Asian University for the Study of Environment and Climate Change-Green University on behalf of the government of Uzbekistan, demonstrate an increased commitment to confronting the threat of the climate crisis while also using it to bolster cooperation (Green University, 2023). However, the design of mitigation and adaptation interventions will be pivotal. Interventions must be peace-positive. Peacebuilding building organizations in the region are making great strides to include a climate sensitivity lens. Implementing organization of mitigation and adaptation projects are however slow to include a conflict sensitivity perspective in their planning. Water-saving technologies such as drip irrigation, water harvesting and potentially agro-forestry and agroPV (shared use of lands for agriculture and energy generation through photovoltaic) may deliver co-benefits and will be key in addition to the much-needed restoration of irrigation systems in the region. However, the adaptation toolbox will have to be diverse and plentiful. In addition, viewing these interconnected challenges through the lens of Feminist Foreign Policy would also shed light on other vulnerable and marginalized groups, such as ethnic or religious minorities. Addressing these groups specifically and supporting civil society through targeted adaptation and mitigation finance should produce co-benefits, increasing resilience as well as improving social cohesion and thus stability in the region. The OSCE Ministerial Decision No. 3/21 - Strengthening co-operation to address the challenges caused by climate change- serves as a joint landmark declaration. Indeed, the OSCE already has projects running in Central Asia that try to mitigate some of the adverse security-relevant impacts of the climate crisis. The six-year project "Strengthening Responses to Security Risks from Climate Change in South-Eastern Europe, Eastern Europe, the South Caucasus and Central Asia" and the project "Women, Water Management and Conflict Prevention – Phase III" both demonstrate that the commitments stated in the ministerial decision from December 2021 is not mere lip service. If enacted in concert with other on-going and planned initiatives such as efforts on behalf of the Team Europe Initiative, the U.S. Government's Central Asia Strategy or the German Green Central Asia Initiative, these projects will serve to make the region more resilient towards the impacts that can no longer be averted and thereby foster a climate for a positive peace in the region.

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Chapter 3

Climate.Changes.Lives.

Impacts of Climate Change on Different Sectors

Securing Austria's Electricity Supply in Times of Climate Change

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The research project SECURES (Securing Austria's Electricity Supply in times of Climate Change) analysed challenges and opportunities for the electricity system of tomorrow to ensure a reliable, sustainable and cost-efficient power supply under climate change. Combining detailed climate and energy system modelling with an intense stakeholder dialogue served as a basis for that. The analysis shows that for an adequate modelling of future energy systems, it is highly relevant to consider the effects of climate change, specifically extreme weather events like heat waves.

1 Introduction

The transition of Austria's electricity system towards a safe and sustainable future in times of climate change brings a broad range of challenges and opportunities into the policy debate where timely decisions on the way forward are of key relevance. On the one hand, energy and specifically electricity demand are expected to undergo significant changes through new demand patterns impacted by climate change and increased sector coupling. On the other hand, a significant transformation process is necessary for the supply side to comply with decarbonisation targets. Within Austria as well as the whole European Union, electricity supply will rely on renewable energy sources (RES), serving as key pillar for a carbon-free electricity supply. Austria has for example set a policy target to generate renewable electricity by 2030 to the extent that the national gross electricity consumption is fully covered (at a yearly balance) – cf. the National Energy and Climate Plan (NECP) (BMNT, 2019). Apart from Austria, also the whole European Union (EU) and its energy system face significant challenges as the EU aims to be climate-neutral by 2050, ten years later than Austria.

The planning and operation of electricity systems are increasingly impacted by climate change and meteorological conditions have become more relevant due to increasing weather-dependent RES shares. The project SECURES (Securing Austria's Electricity Supply in times of Climate Change) analysed challenges and opportunities for the electricity system of tomorrow to ensure a reliable, sustainable and cost-efficient power supply under climate change. Geographically the analysis was focused on Austria but involved also other European countries to reflect the interconnected character of Europe's electricity system. Combining detailed climate and energy system modelling with an intense stakeholder dialogue served as a basis for this process.

This paper provides an overview on the approach taken and some key results derived within the SECURES[1] project. The applied structure is as follows: After the introductory part an overview on the methodology is provided (cf. section 2). Next to that follows a detailed reflection on key results and findings, structured alongside the workflow of the project: In section 3, climate change projections and the processing of those, serving as input for the subsequent energy system analysis, are presented. Section 4 subsequently informs on changing patterns in electricity demand and supply driven by climate change whereas the identification of critical system conditions in the electricity sector is already described in the methodology part (section 2). All previous steps serve as basis for the subsequent electricity sector modelling which is presented in section 5. A focus is thereby laid on security of supply aspects, undertaken from a system adequacy perspective. The paper ends with a brief list of conclusions and policy recommendations on the way forward (section 6).

2 Method of approach

2.1 General methods and concepts in SECURES

The work within SECURES builds on a combination of detailed climate and energy system modelling with an intense stakeholder dialogue. It includes an in-depth analysis of structural changes in weather and electricity demand and supply resulting from two climate change projections in combination with decarbonisation pathways. In practical terms, the work in SECURES was clus-

[1] For further background information on the SECURES project we refer to the project website www.secures.at.

tered into five topical work packages and rested on three key pillars (cf. Figure 1 on the next page). Two electricity sector transformation pathways were defined and several different weather years for the transition of Austria's electricity sector in times of climate change were assessed. The outcomes are published and documented open access. An intense stakeholder consultation was conducted throughout the project, informing on the planned approach, and incorporating their feedback on the definition of scenarios as well as other analytical steps.

Below we provide details on the underlying approach for the individual working steps.

2.2 Methods and concepts in climate modelling

The requirements for meteorological datasets for electricity modelling are high. On the one hand, a high temporal resolution is required, as the typical time step for modelling electricity production and demand is one hour. On the other hand, the European electricity market is highly connected, so pure country-based modelling is not expedient. Additionally, the spatial resolution of the dataset must be able to represent the thermal conditions, which requires high spatial resolution, at least in mountainous regions. All these requirements lead to huge data amounts for historical observations and even more for climate change projections for the whole 21st century. The final outcome of that is a publicly available dataset named SECURES-Met (Formayer et al., 2023).

The historical dataset was created from the hourly resolved 5th Generation of the ECMWF Reanalysis (ERA5) (Hersbach et al., 2020) and ERA5-Land (Muñoz-Sabater et al., 2021). Climate change projections were selected from daily resolved models from the European Coordinated Regional Climate Downscaling Experiment (EURO-CORDEX) (Jacob et. al., 2014), with the selection being narrowed by the availability of hydrological data (Donnelly et al., 2016). Two scenarios were selected, one representing a business-as-usual development (Representative Concentration Pathway (RCP) 8.5 – strong climate impacts) and another one representing carbon emissions close to the Paris Agreement (RCP4.5 – moderate climate impacts). Although the change to a new generation of climate models with the new Shared Socioeconomic Pathways (SSPs) recently was done by the community, the lack of regional downscaling with regional climate models led to the decision to keep the older generation with the Representative Concentration Pathways (RCPs).

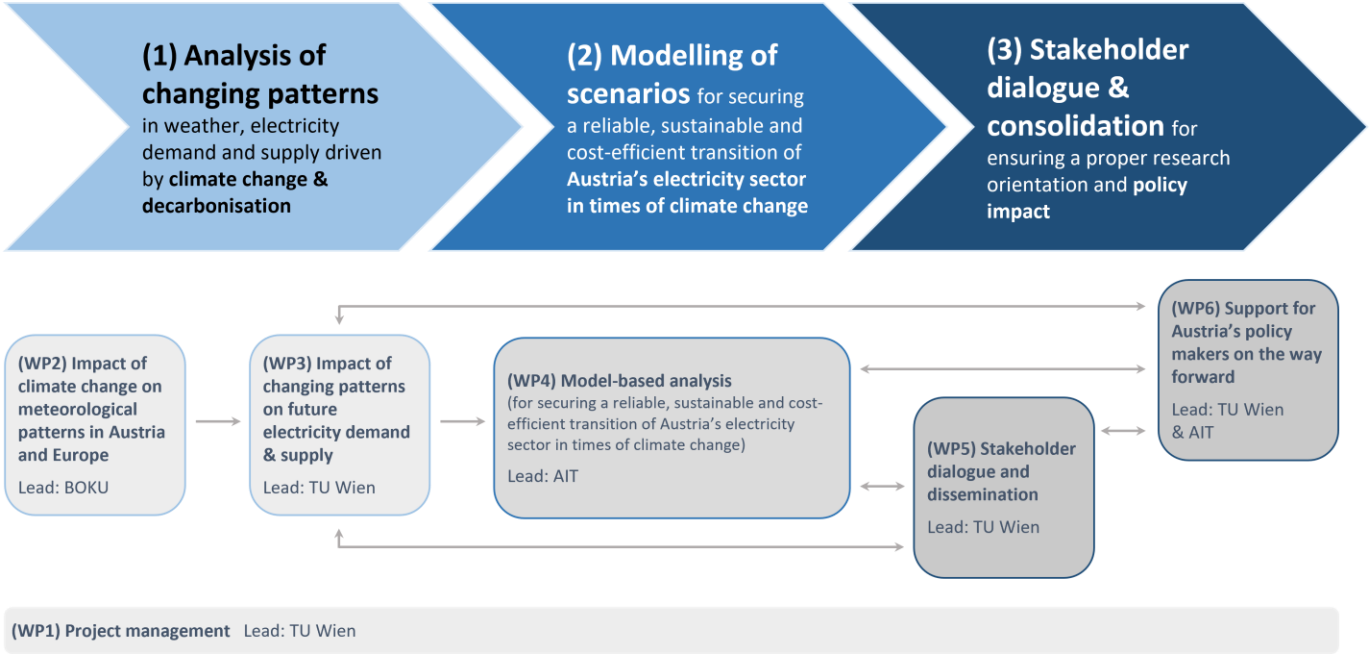


Figure 1: Work structure – the three pillars (and the corresponding work packages) of SECURES. (own elaboration)

All tables and charts in this article are the authors' own productions.

The further comprehensive processing comprised various steps, including for example:

- a conversion ("regridding") in accordance with land use and population data,
- bias corrections using historical data of 1991-2020 from ERA5 and ERA5-Land via a quantile-mapping procedure that adjusts the distribution of the models to the historical climatology and their quantiles (Lehner et al., 2023),
- a temporal disaggregation from daily to hourly data, using statistical approaches, and
- individual processing steps for solar radiation, wind and hydro as described in the Final Report of the SECURES project (Schöniger et al., 2023)

Finally, geographically detailed climate data had to be aggregated again to allow for the further use in energy system modelling where individual countries are typically represented by one single node (NUTS0).

2.3 Methods and concepts in energy system modelling

At the energy side, various steps are required to conduct the analysis of both the decarbonisation needs and the climate impacts on Austria's electricity sector of the future, embedded in the European context. Below we describe the approach taken for the individual steps in further detail.

2.3.1 Assessing climate change impacts on future electricity demand and supply

Since meteorological parameters cannot be used directly in energy system modelling, a conversion to supply and demand profiles as commonly applied in energy system models is required. Thus, based on the meteorological variables derived from the two climate scenarios (cf. section 2.2), the dataset SECURES-Energy was created. This dataset contains hourly weather-dependent electricity generation and demand profiles that can be used in energy system modelling. In practical terms, the hourly time series of these climate data were retrieved and further converted to electricity demand and supply profiles.

On the generation side, generation profiles of wind power, hydropower (run-of-river (RoR) and reservoir), and solar photovoltaics (PV) were generated. Additionally, the impact of temperature on thermal power plant efficiency was considered. On the demand side of the system, electricity demand profiles for heating, cooling, and e-mobility charging were generated. Details on the approach taken for that purpose are described in the Final Report of the SECURES project (Schöniger et al., 2023).

2.3.2 Definition of scenarios for the electricity sector transformation

The main aspect of scenario design comprised the combination of energy transition pathways for Austria/Europe up to 2050 with appropriate climate scenarios formed from simulations in accordance with the two RCPs. Accordingly, **two distinct energy transformation pathways** have been identified – i.e., a Reference (REF) and a Decarbonisation Needs (DN) pathway for the focal years 2030 and 2050:

- For the REF pathway and corresponding scenarios, Austrian and EU-wide existing measures and goals, including 2030 emissions targets, were considered as identified in the national trends scenario of TYNDP2022 (ENTSO-E and ENTSOG, 2022). It relies on the 100% RES-based electricity system for Austria by 2030 (national balance sheet). However, it represents less decarbonisation ambition in other sectors and EU countries and is accordingly expected to match with a strong climate change scenario (RCP 8.5).

- On the contrary, the DN pathway represents a strong decarbonisation ambition across the whole EU based on Resch et al. (2022) and was coupled with a medium climate change scenario (RCP 4.5). Here, the measures are considered to achieve full decarbonisation by 2050. That implies a strong sector-coupling and decarbonisation of other sectors, such as industry and mobility.

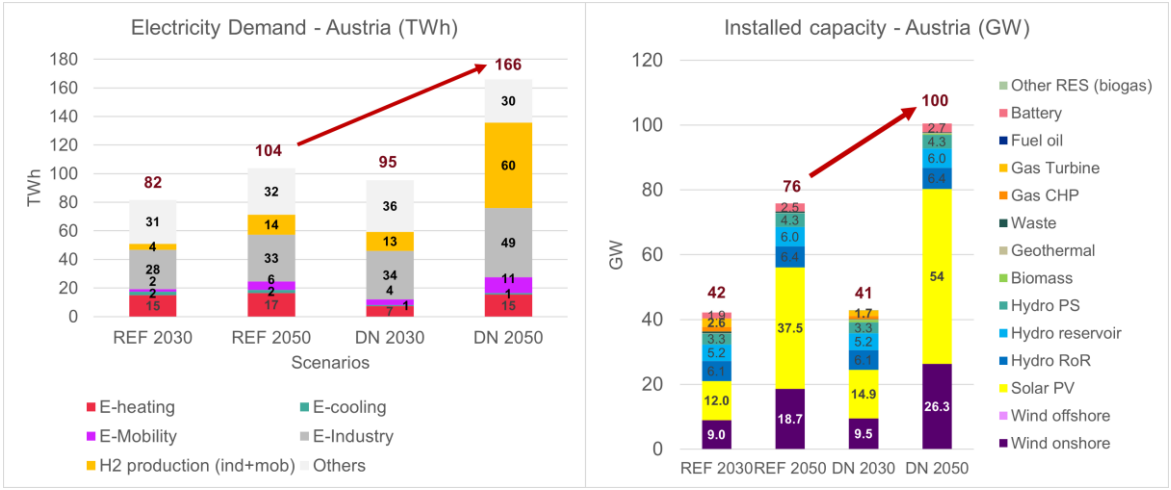


Figure 2: Default demand (left) and capacity projections (right) for Austria according to SECURES energy transformation pathways (REF and DN). (own elaboration)

Figure 2 illustrates the demand (left) and installed capacity (right) projections for Austria for both the REF and DN pathways. Due to the strong sector coupling and electrification driven by decarbonisation, electricity demand in the DN scenario is forecasted to increase by approximately 70 TWh in 2050 compared to the REF. This demand is expected to be met by about 24 GW of additional capacity, mainly stemming from PV and wind. Since the overall assessment focused on supply security for both pathways described above, for the mid-future (2050), Security of Supply variants were analysed as well, assuming extreme weather conditions (i.e., dark doldrums and heat waves) in accordance with climate data coupled with conservative assumptions for critical system bottlenecks.

Table 1 presents an overview of all modelled scenarios. In this analysis, the term "scenario" is used to refer to the modelling of a full calendar year (according to climate/weather data provided on an hourly basis) in combination with a specific trend path for the transformation of the energy sector, i.e. REF or DN. In terms of time, the study analysed two key years that represent distinct levels of transformation: the near future (2030) and the mid-future (2050). According to the DN pathway, the transformation process would be completed by 2050, resulting in complete decarbonisation of both the energy

sector and the wider economy. Climate impacts are presented for various weather years in 2050 scenarios, including a typical year and two extreme years, which are years with either a dark doldrum or a heat wave.

Table 1: Overview of assessed scenarios (own elaboration)

Scenario acronym:	REF 2030 NY	DN 2030 NY	REF 2050 NY_2008	REF 2050 NY	REF 2050 HW	REF 2050 DD
Reference period:	2030	2030	2050	2050	2050	2050
Energy trend pathway:	REF	DN	REF	REF	REF	REF
Weather pattern:	Normal Year	Normal Year	Normal Year w/o CC	Normal Year	Heat Wave	Dark Doldrum

Scenario acronym:	DN 2050 NY_2008	DN 2050 NY	DN 2050 HW	DN 2050 DD
Reference period:	2050	2050	2050	2050
Energy trend pathway:	DN	DN	DN	DN
Weather pattern:	Normal Year w/o CC	Normal Year	Heat Wave	Dark Doldrum

2.3.3 Approach for the identification of critical system conditions

In SECURES, the possible critical weather years for modelling were observed and identified from two different perspectives. Firstly, this was analysed from a meteorological point of view, where the choice of extreme and reference years was mainly determined by temperature patterns, and secondly, from an energy system point of view, where the indictor residual load (RL) was used. RL represents the difference between demand and variable weather-dependent RES, including solar PV, wind and hydro RoR. The negative RL indicates a surplus generation, whereas the positive RL implies the generation deficit. Here, RL is calculated for each month and the critical RL years were compared with the meteorological extreme years.

Apart from the electricity generation profile of variable RES, RL is the key parameter for identifying extreme events from the power system perspective. Following the method outlined by Dawkins and Rushby (2021), some pri-

mary indicators were calculated per country, as well as the EU and Central Europe to identify extreme weather events from the power system perspective, of which one was of key relevance for further elaborations:

Peak Periods of Residual Load (PPRL): Identified periods where, over a time span larger than seven days, the average weekly RL (sliding average of 7 days) is above its 80th percentile of the positive RL (representative for dark doldrums and/or heat waves).

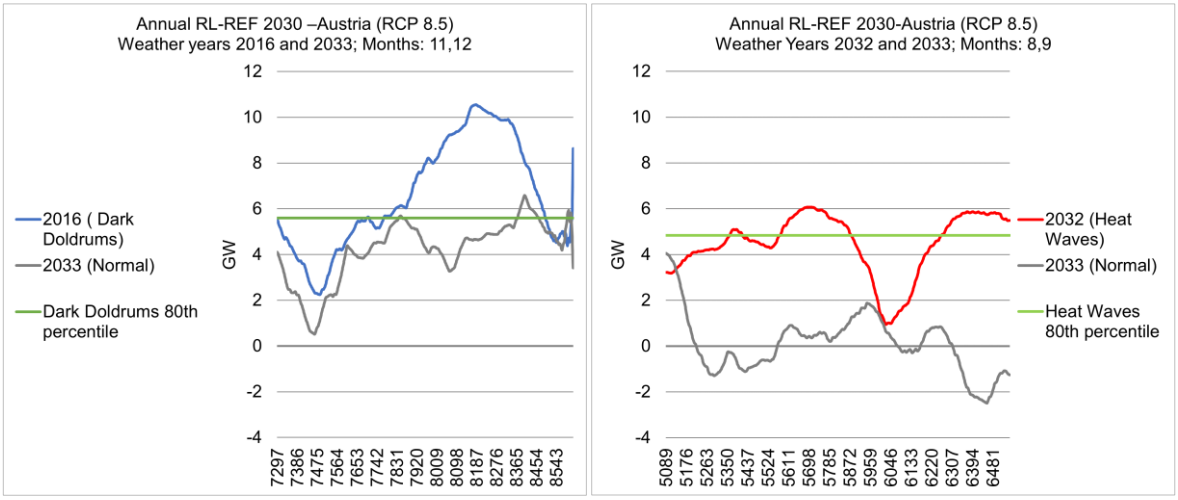


Figure 3: Representation of Peak Periods of Residual Load (PPRL) in the case of REF-2030 by considering RCP 8.5. (own elaboration)

The indicator PPRL was then used to identify the weather years used for the energy system modelling: One normal and two extreme years (with either a dark doldrum or a heat wave) were proposed for the RCP 4.5 (for DN scenarios) and RCP 8.5 (for REF scenarios), which were considered to create stress events from a system perspective, cf. Figure 3. For the selection of weather years, this indicator was not only considered for Austria but also for Central Europe, with which Austria's power system is strongly interconnected. The overlap of the identified weather years for the energy system modelling from an energy system point of view and identified from a purely meteorological point of view was high. Table 2 shows the final list of selected weather years for the energy system modelling scenarios.

Table 2: Selected weather years based on residual load analysis & duration of Peak Periods of Residual Load (PPRL) (own elaboration)

RCP4.5 (DN Scenarios)	**2030**	**2050**
Representative year (Normal)	**2043**	**2062**
Heat Wave	**2028** (23 days starting in week 27)	**2046** (week 38 and 39)
Dark Doldrums	**2037** (50 days starting in week 1)	**2037** (49 days starting in week 2)
RCP8.5 (REF Scenarios)	**2030**	**2050**
Representative year (Normal)	**2033**	**2049**
Heat Wave	**2032** (14 days starting in week 38)	**2057** (40 days (CEU) starting in week 31)
Dark Doldrums	**2016** (9 days starting in week 3; 30 days starting in week 47)	**2047** (17 days (CEU) starting in week 47)

2.3.4 Methods and tools used in electricity sector modelling

For the modelling, the open-source **energy system modelling tool Balmorel** (Ravn, 2016) was used. This model is a partial equilibrium model for analysing the electricity and district heat from an integrated perspective. In this study, the base model structure was extended with different flexibility options.

Geographically, modelling covered Austria and other European countries (i.e., EU plus Switzerland, Norway and the United Kingdom) to accurately represent the interconnectivity of Europe's electricity system. Timewise, a focus was put on specific years in the near (2030) and mid-future (2050) whilst modelling was conducted for the whole year at an hourly resolution. The scenario design focused on combining two distinct energy sector transformation pathways (cf. section 2.3.2) for Austria/Europe up to 2050 alongside the two climate scenarios described above.

The analysis centred around the security of supply aspects, specifically related to system adequacy, done via an **assessment of future system flexibility needs** to achieve a proper match between demand and supply during all time

steps, i.e., during all hours of the modelled years. Apart from the identification of the demand for flexibility, modelling also showed how that flexibility can be provided in a cost-effective manner. Thus, additional investments in certain flexibility options at the supply and the demand side as well as for storage and, to a limited extent, for the cross-border grid infrastructure to enable cross-border electricity exchange were allowed model-wise, with differences between scenarios and years:

- Flexible generation technologies: Combined heat and power (CHP) and thermal power plants (natural gas, biomass, and other power plants, including biogas engine and waste incineration),
- Curtailment to manage oversupply (PV, wind, hydropower plants),
- Transmission network (cross-border exchange) (no (2030) or limited (2050) extension, i.e. at max. +20% above planning) (ENTSO-E and ENTSOG, 2022),
- Load management via Power-to-Heat (P2H) (electric boilers and heat pumps in district heating and in decentralized buildings) (30%/75% flexible operation in 2030/2050),
- E-mobility (25%/75% flexible charging in 2030/2050),
- Industrial load management (5%/10% flexible operation in 2030/2050),
- Power-to-Gas (Hydrogen): electrolyser, H2 storages and re-electrification,
- (Pumped) hydropower storage plants (no extension beyond planned according to ENTOS-E and ENTSOG [2022]),
- Lithium-ion batteries and prosumers.

For the **definition of flexibility**, we followed the approach of Suna et al. (2022) who define flexibility as *"the capability to promptly (i.e., within one hour) change the generated or consumed electricity at a defined network node"*. Accordingly, we assessed flexibility needs and their coverage on the power system level (short-term, i.e., balancing hourly fluctuations within a day) and on the energy system level (incl. medium-term, i.e., balancing daily and weekly fluctuations, and long-term, i.e., balancing monthly fluctuations). This helped to elaborate on security of supply aspects at a system level and allowed for identifying key system assets for achieving the match between demand and supply under the considered time scales and system boundaries. Consequently,

please note that flexibility for voltage or for solving grid congestions are not part of our study.

3 Climate change projections data

A comprehensive meteorological dataset (SECURES-Met) for Austria and Europe specifically designed for that purpose was created by an iterative creative process between meteorologists and energy modellers to fit energy modelling requirements (NUTS0-NUTS3 level, hourly resolution).

SECURES-Met (Formayer et al., 2023) covers the years 1981-2020 for the historical period and up to 1981-2100 for two GHG-emission scenarios, i.e., one with moderate (RCP 4.5) and one with stronger climate impacts (RCP 8.5). Derived variables include temperature, radiation, wind power and hydropower potential (separated into run-of-river (RoR) and reservoir).

4 Changing patterns of electricity Supply and Demand Driven by Climate Change

Hourly profiles of weather-dependent supply and demand components for solar, onshore and offshore wind, hydro reservoir, and hydro RoR generation were generated using meteorological variables obtained from two different climate scenarios. Also, hourly e-heating, e-cooling, and e-mobility demand profiles for the years 2011-2100 were obtained. These data formed the basis for the subsequent energy system modelling.

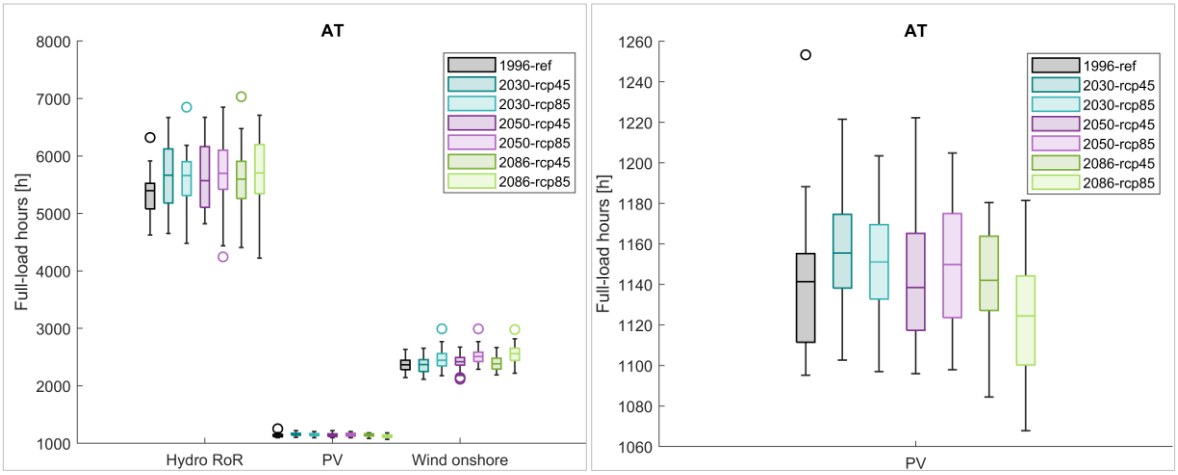
The development of full-load hours (FLH) of the different renewable generation technologies wind, RoR hydropower, and solar PV for Austria were analysed based on their hourly profiles until 2100. The following figures show the impact of climate change over time (2030, 2050, and 2086) and the differences between the two climate scenarios (RCP4.5 and RCP8.5). Each box represents the 30 weather years around the target year. The data for the reference period is based on the years 1981-2010 of ERA5(-Land).

The highest interannual variability is observed for RoR hydropower, while onshore wind and especially PV show lower interannual variability, cf. Figure 4, panel (a). The interannual variability of PV and the number of FLH (Figure 4, panel (b)) show no clear trend for PV in Austria in the considered

climate scenario (based on the 30 weather years around the target year). In the historical period (1981-2010), one year with exceptionally high FLH is visible, which represents the very hot summer in 2003 in the ERA5-Land data.

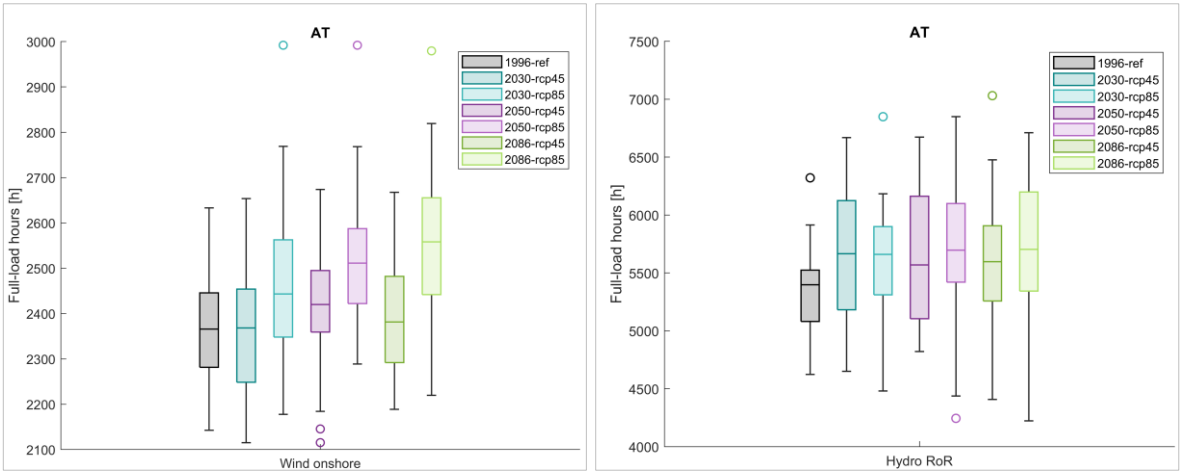
For onshore wind (Figure 5, panel (a)), no clear trend of interannual variability and number of FLH is observed in the RCP 4.5 scenario. In the RCP 8.5 scenario onshore wind FLH are higher than in the RCP 4.5 scenario in Austria in the two analysed climate scenarios.

For RoR hydropower (Figure 5, panel (b)), no clear trend regarding the FLH can be observed, with the median of FLH in the considered climate scenarios being slightly higher than in the reference period. The interannual variability increases, especially after the mid of the century in the climate scenarios. In literature, the projections of climate change on hydro RoR FLH are heterogeneous depending on the considered climate scenarios, as some former studies using older generations of climate scenarios showed decreasing FLH for RoR hydropower in Austria (Totschnig et al., 2017).



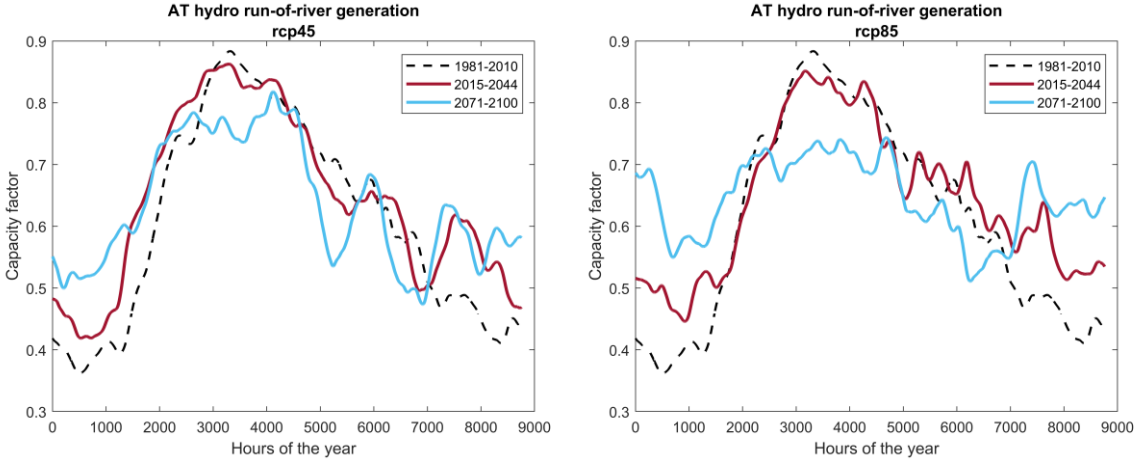
a) b)

Figure 4: Development of FLH of RoR hydropower, PV, and onshore wind (panel (a)) and PV in greater detail (panel (b)) in Austria in the two considered climate scenarios (RCP4.5 and RCP8.5) compared to the reference period (1981-2010); each box represents 30 weather years around the target year; the reference period is based on ERA5-Land. (own elaboration)



a) b)

Figure 5: Development of FLH of onshore wind (panel (a)) and RoR hydropower (panel (b)) in Austria in the two considered climate scenarios (RCP4.5 and RCP8.5) compared to the reference period (1981-2010); each box represents 30 weather years around the target year; the reference period is based on ERA5-Land. (own elaboration)

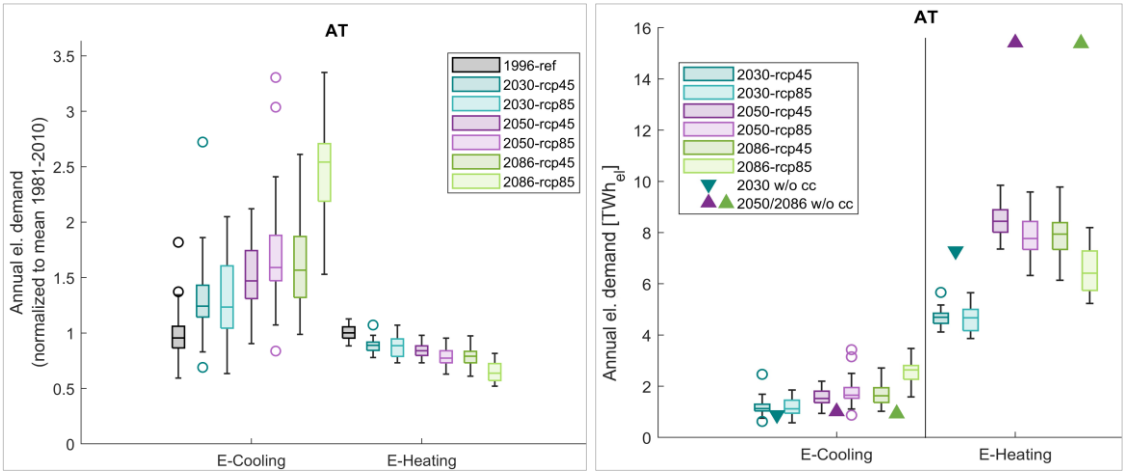


a) b)

Figure 6: Development of seasonal generation patterns of run-of-river hydropower in Austria in two emission scenarios (Panel (a): RCP4.5, Panel (b): RCP8.5) compared to the reference period 1981-2010 based on ERA5-Land.

Climate change impacts the seasonal patterns of RoR hydropower in Austria (cf. Figure 6). There is a seasonal shift towards earlier runoff in spring with ongoing climate change, accompanied by reduced generation in summer and increased generation in winter. This change is partly due to changing precipitation patterns, with rain replacing snowfall during winter, leading to higher winter runoff and reduced snowmelt in spring.

On the demand side, a decrease of the annual heating demand (up to -50% compared to the reference period in the RCP8.5 scenario at the end of the century) and an increase of the cooling demand (up to +350% compared to the reference period in the RCP8.5 scenario at the end of the century) are projected with increasing climate impacts in Austria (cf. Figure 7).



a) b)

Figure 7: Panel (a): Development of e-heating and e-cooling demand in Austria (normalized to the mean of the reference period 1981-2010); each box represents 30 weather years around the target year; the reference period is based on ERA5-Land; Panel (b): Absolute values according to the DN scenario; the reference demand without additional climate change (triangles) would be the demand in a 2030/2050 energy system but based on the mean temperatures 1981-2010 of ERA5-Land. For 2050 and 2086, the same energy system is assumed (full decarbonisation). (own elaboration)

The difference between the two emission scenarios becomes notably clear towards the end of the century. The median level of cooling demand in the RCP8.5 scenario already reaches a level in the period 2035-2064 that is not reached until 2071-2100 in the RCP4.5 scenario. The seasonal shift due to

the increase of demand during summer and the decrease during winter correlates to the seasonal pattern of solar PV and (historical) patterns of hydropower generation and may consequently reduce the need for seasonal storage in the electricity system in Austria.

5 Results from the Electricity sector modelling

This section is dedicated to the results of the energy system modelling with particular emphasis on Austria's electricity sector, embedded in an interconnected European market and its growing importance within the whole energy system along the way towards decarbonisation. As described above, a broad set of scenarios has been modelled: Two distinct pathways on the energy system transformation (REF, DN) have been assessed for two focal points in time (2030, 2050). The year 2050 appears of particular interest since it marks the end date for full decarbonisation in Europe under the DN pathway.

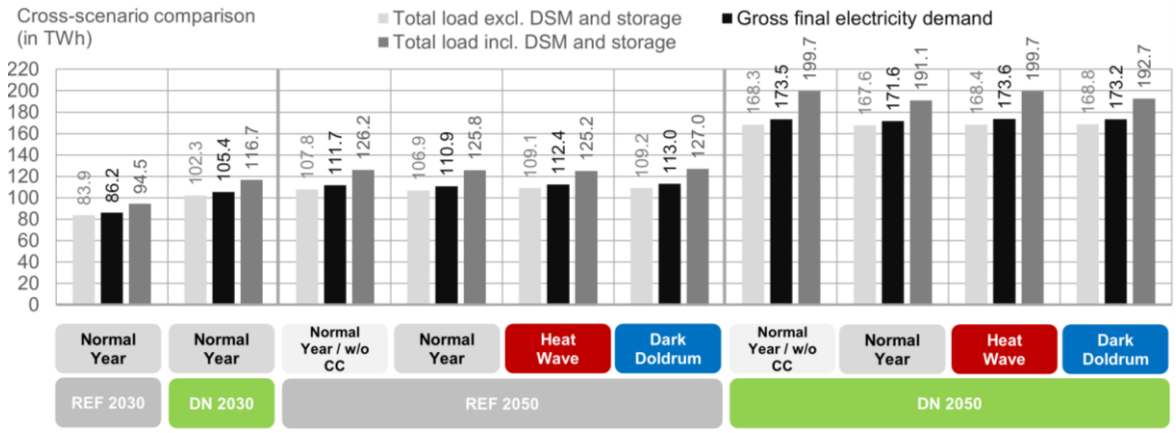


Figure 8: Comparison of electricity demand (with and without additional demand components for storage and DSM) in Austria across assessed scenarios by 2030 and 2050. (own elaboration)

Figure 8 provides a comparison of **electricity demand** (with and without additional demand components for storage and demand-side management (DSM)) for assessed scenarios by 2030 and 2050. It shows the challenges that come along with the energy transition that is indispensable from a climate and societal perspective. Gross final electricity demand is expected to grow by 55% by 2050 compared to today (2021) in REF, whereas the DN pathway

implies a growth of 140%. As stated previously, the higher demand for electricity is driven by sector coupling and the ongoing electrification that comes along with decarbonising energy services in transport and industry.

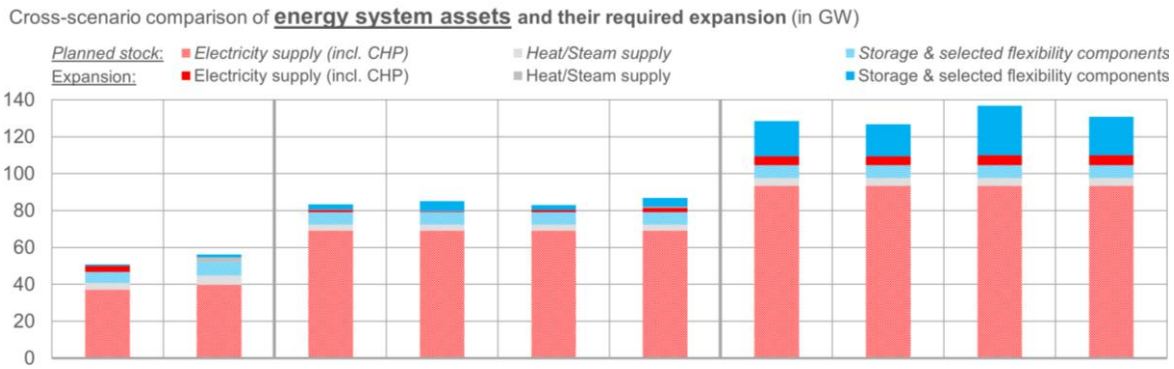
How does climate change impact the above? On the demand side, for normal weather conditions, aggregated impacts appear marginal, partly due to the compensating effects of heating and cooling and partly due to the comparatively low share of weather-dependent load in overall electricity demand in decarbonised energy systems. Thus, only small differences are applicable between default electricity demand also when considering additional demands for storage or for demand response measures. Extreme weather events like heat waves or dark doldrums affect that situation. At a yearly balance, corresponding increases in demand (compared to a normal year) are comparatively small, ranging from 1% to 2%, but during the affected time periods within a year, a demand increase of 4% to 11% is observable in the underlying load pattern.

Next, we present a focus on the **supply side and other system assets** like storage systems that provide the required flexibility to Austria's electricity system for a proper match between demand and supply. In this context, Figure 9 illustrates how the climate mitigation ambition (REF vs. DN) and climate-driven weather impacts affect the (ideal) stock of energy system assets in future. In modelling, on top of the planned stock of generation and storage assets, additional investments in certain flexibility options were allowed (cf. section 2.3.4). Accordingly, Figure 9 offers a cross-scenario comparison of these assets and thereby undertakes a distinction between their planned uptake and the required expansion.

Comparing DN and REF, a significantly stronger uptake of assets on the supply side is applicable, specifically in wind and PV. Thus, under normal weather conditions, the total stock of electricity generation assets is about 40% higher in DN compared to REF. With higher amounts of weather-dependent generation, short-term fluctuations in electricity generation grow, requiring large amounts of system flexibility to ensure the match between demand and supply in every hour. A comparison between DN and REF indicates the significantly larger amount of flexible storage, generation and demand assets required by 2050. According to modelling, the total stock of storage and selected demand-side flexibility components in capacity terms is then ca. 170% higher in DN than in REF.

Concerning climate change impacts on the supply side, high interannual variations are visible and impacts are highly dependent on the chosen weather year. For normal weather conditions, wind and RoR hydropower show a slightly higher annual generation, whereas, for solar PV, negligible differences are observable in the modelled normal weather years in line with the long-term climate projections.

Of key importance for the analysis of climate impacts is the **consideration of extreme weather events** since, with ongoing climate change, the frequency and duration of such events increase according to climate data (Formayer et. al., 2023). In our analysis, a heat wave and a dark doldrum serve as a stress test for security of supply. Results from 2050 DN scenarios show that for safeguarding electricity supply under assessed extreme conditions, in comparison to a normal weather year neglecting climate impacts, a stronger uptake of wind energy by 20% appears useful from a least-cost system perspective. Investments in wind thereby replace those in green gas assets, as applicable in scenarios related to normal weather conditions. For storage and demand-side flexibility assets, there are both similarities and differences between a heat wave and a dark doldrum: For both events, modelling suggests increasing the H_2 electrolyser stock by 72-74% (compared to a normal year neglecting climate impacts) as well as accompanying H_2 storage, allowing a system-friendly operation of the electrolyser fleet. In a dark doldrum, thermal storage is found to be useful for load shifting at both the heat and the electricity side as a consequence of increased sector coupling via heat pumps or CHP. In the case of a heat wave, when hydro and wind generation is generally low, batteries are the key system asset since they help to shift the high PV infeed during daytime into evening hours when the sun is not shining.



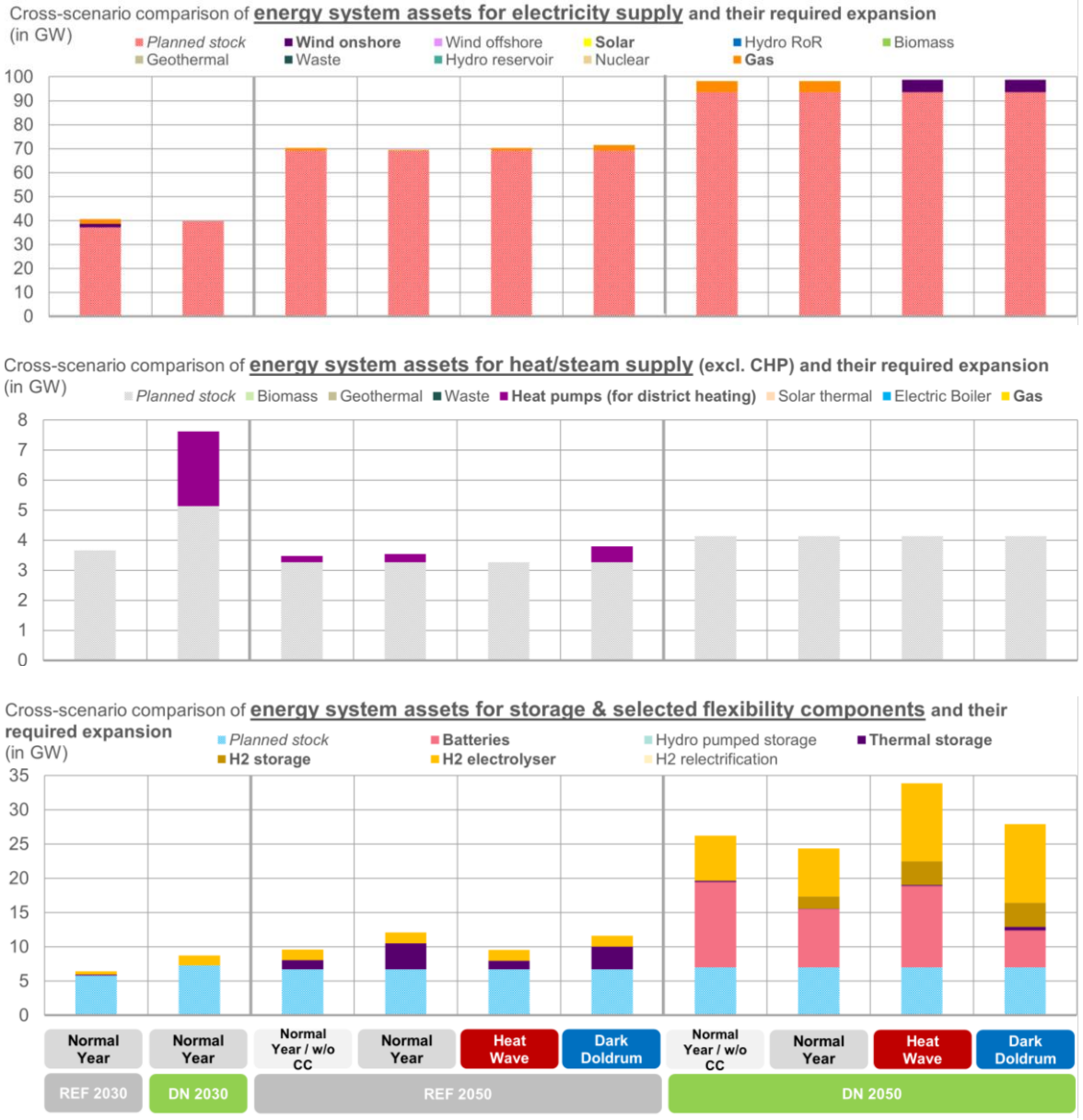


Figure 9: Comparison of Austria's energy system assets and their required expansion in aggregated terms (top), for electricity supply, heat/steam supply and for storage & other selected flexibility components (bottom) across scenarios by 2030 and 2050. (own elaboration)

Next, Figure 10 compares the identified **flexibility needs**, broken down by time period for all assessed scenarios and years (2030, 2050). A strong increase of flexibility needs is applicable when comparing 2030 and 2050 as well as with growing decarbonisation ambition (REF vs DN). For mid- to long-term flexibility, the increase is in accordance with demand growth. Short-term flexibility is, however, growing faster – here, the significant uptake of variable RES plays a key role. Complementarily, Figure 11 informs on the provision of flexibility broken down by time period for the assessed scenarios.

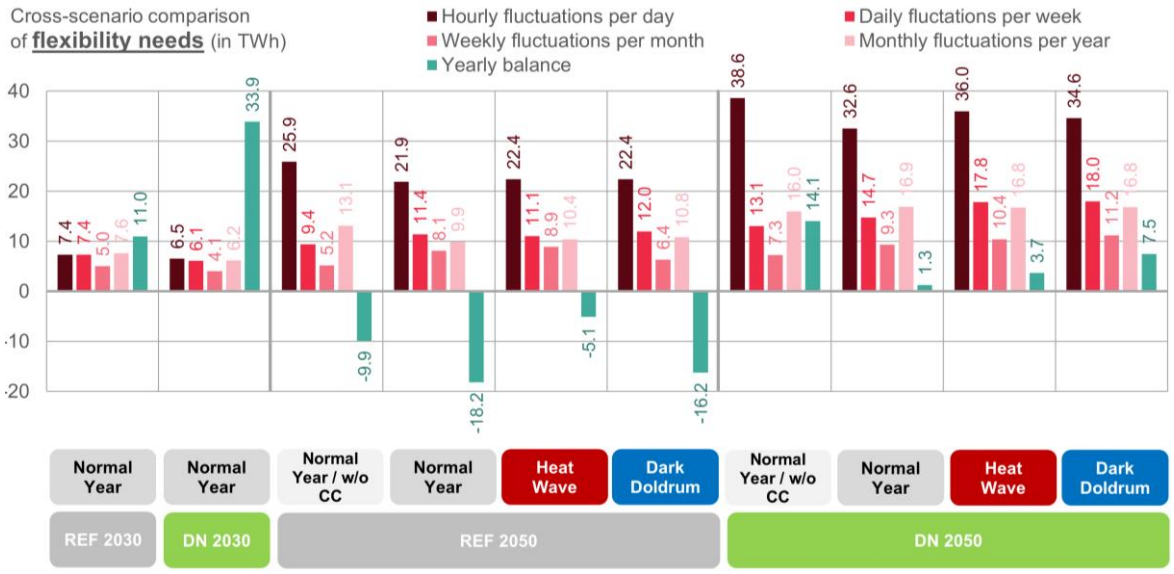


Figure 10: Cross-scenario comparison of flexibility needs under different time periods within Austria's future electricity system by 2030 and 2050. (own elaboration)

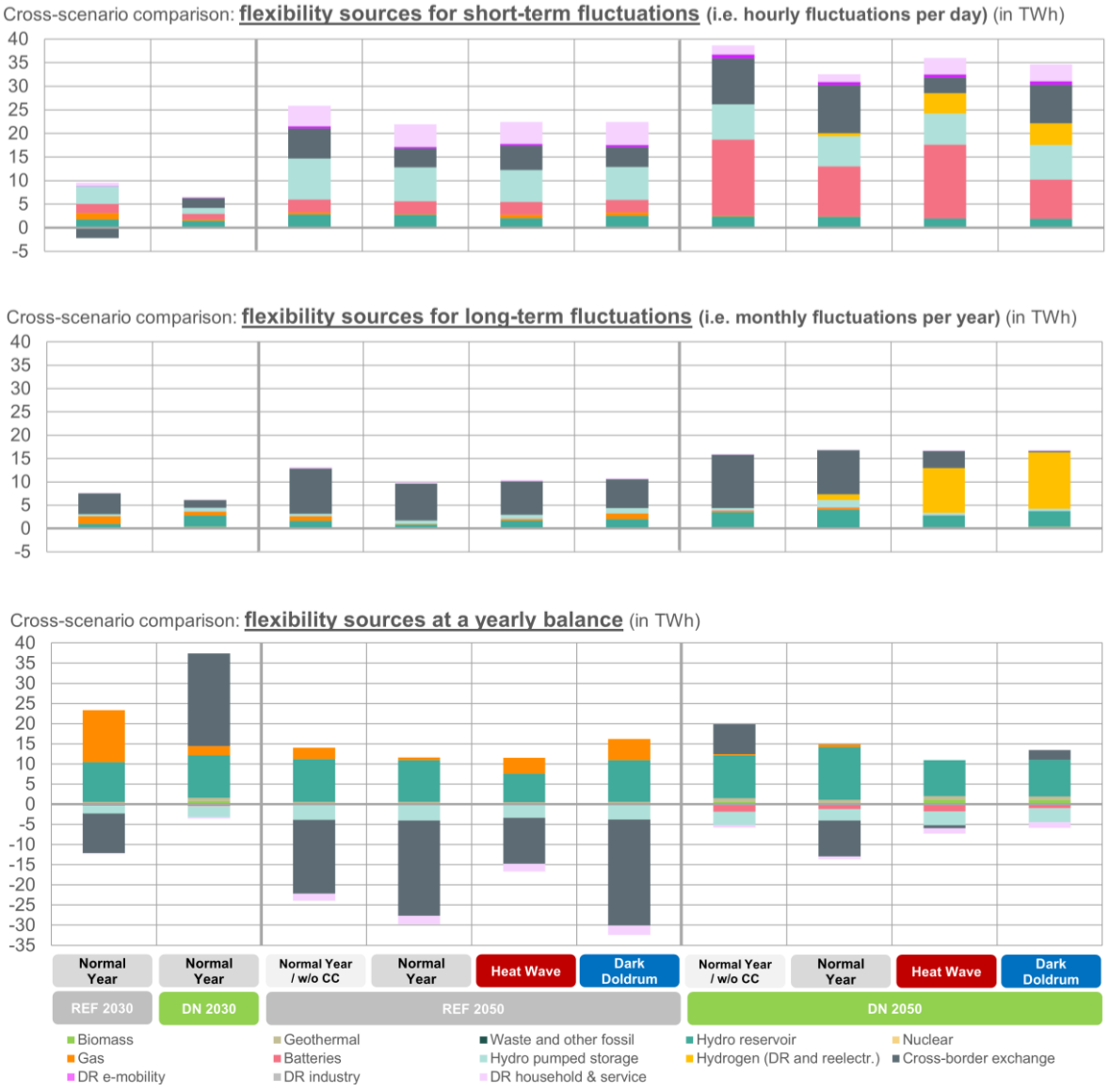


Figure 11: Cross-scenario comparison of the contribution of flexibility sources to cover needs at selected distinct time periods, short-term and long-term fluctuations as well as at a yearly balance within Austria's future electricity system by 2030 and 2050. (own elaboration)

According to the modelling, the following patterns were identified:

- Demand response in households, services, and industry, as well as in e-mobility, contributes to balancing short-term fluctuations in the RL.
- Batteries show a similar pattern as flexible consumers, helping to cope with massive short-term fluctuations, specifically under the DN pathway. They are an essential asset in extreme weather events like heat waves.
- Hydro reservoirs and Pump Storages (PS) allow for flexible use in all time ranges. Usage patterns show that for PS, the contribution is typically higher in the short to medium term, whereas for reservoirs, the opposite trend is applicable, helping to cover seasonal imbalances and the yearly RL balance. Both are relevant to cope with extreme weather events.
- Cross-border exchange of electricity remains a central pillar of flexibility in Austria's future electricity market, both to utilise surpluses and to compensate for deficits. In modelled years of extreme weather events, their contribution is, however, smaller than under normal weather patterns.
- Thermal storage and H_2 storage are essential system components of a decarbonised Austrian energy system. Specifically, H_2 storage units allow for a flexible and system-friendly operation of H_2 electrolysers, which, in turn, help to cover flexibility needs at various time scales and during critical weather extremes.

6 Conclusions and recommendations

The analysis shows that for an adequate modelling of future energy systems, it is highly relevant to consider the effects of climate change. The consideration of extreme events is crucial for planning a resilient energy system in the future, not only for Austria but also for Europe since both the short- and the long-term flexibility needs are strongly affected by changing weather patterns. The following recommendations can be derived:

- For enhancing the energy transition towards decarbonisation, strong investments in energy system assets are indispensable, be it at the generation, demand or storage side or concerning grid infrastructure. This has been demonstrated by the modelling undertaken in the SECURES project. Specifically, storage and the inclusion of the demand side appear of key relevance to safeguard the match between demand and supply in the electricity sector during all time steps.
- To best cope with future climate impacts, it is necessary to make Austria's electricity sector future-proof and climate-ready. In future years, most of the electricity supply within Austria as well as in other parts of Europe will rely on weather-dependent renewable energy sources like wind, solar, or hydro. Thus, in practical terms, this implies considering for planning purposes not only default weather conditions. Instead coping with extreme weather situations, specifically heat waves and dark doldrums, shall become the new standard in energy system planning.
- Apart from investments in various system assets, it is a key necessity to establish markets and include an increasingly broad set of actors. Today there is a gap in markets for flexibility services. Once established, rules for the participation of various market actors need to be simple and transparent for enlarging the outreach.

7 Acknowledgement

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Climate Change and International Security: Challenges for the Austrian Military Geoservices

Gerhard Herda

Military geoscientific expertise may contribute to international security with regard to the complex developments caused by climate change. In addition, there are developments and future challenges concerning the military geoservices that relate to the preparation of the Austrian Armed Forces for fast-changing environments.

Introduction

The anthropogenic emissions of greenhouse gases have led to a rise in global average temperature of 1.1°C compared to the measurements of the late 19th century. This ongoing trend is caused by unsustainable energy use, land use, land-use change as well as patterns of consumption and industrial production. Although almost all countries contribute to higher concentrations of greenhouse gases in the air, the individual contributions of states are highly uneven (IPCC, 2023).

Geologically speaking, a higher global temperature leads to very rapid climate change, which, in turn, causes devastating weather phenomena and changes in the appearance of the Earth's surface. As a result, an increase of the global sea level, extreme weather events and extreme temperatures put a strain people all over the world. Serious problems, for example water or food shortages, health problems and an escalation of distributive injustice pertaining to daily necessities, result in accelerated socio-economic changes, which may threaten both national and international security (UN, 2021; German Federal Ministry for Economic Cooperation and Development, 2008).

There is a large number of publications dealing with the geoscientific problems of climate change, and almost every member country/participating State of the EU, OSCE or NATO has implemented the risks of climate change related to security in their national military strategies and policies. This study aims to bridge both poles, the geoscientific and the political

spheres, and elaborates on the military challenges of the effects of climate change on international security from the perspective of Austrian military geography. The findings should serve both members of international military geoservices and interested policy-makers with a military and/or security background.

Austrian military geoscience

Modern military organisations such as the United States Armed Forces, the British Armed Forces or the German *Bundeswehr* have highly specialised organisational structures dealing with the wide range of military geographical needs. However, international military geosciences are often referred to as "military geology", "geospatial intelligence" or, more generally, "Geoinformation Centre" and involve the application of geoscientific knowledge and techniques to support military operations and national security.

The dynamic interaction of geofactors such as "lithology", "water", "soil" and "weather" strongly affects military personnel, operational readiness, military assets, equipment and infrastructure not only during military operations but also during times of peace. Therefore, the following key tasks and contributions of international military geosciences can be defined:

1. Terrain analysis and geospatial intelligence

   Military geoservices use geospatial data, satellite imagery, aerial photography, and geographic information systems to gather, analyse and interpret information for military purposes. This may include identifying enemy positions, monitoring changes on the battlefield, and assessing the suitability of terrain for various operations. Therefore, geoscientific analyses of terrain and topographic features are fundamental to understanding their impact on military operations. This includes assessing factors such as slope, elevation, vegetation cover, and geological formations that may affect troop and vehicle movements, visibility, and defence strategies.

2. Environmental impact assessment

   For any military activity, it is important to systematically evaluate its environmental impact, including the potential effects of weapons testing, troop movements, and infrastructure constructions on the natural

environment. This information is crucial for minimising environmental damage and complying with international agreements.

3. Resource assessment

   Understanding the availability of natural resources, such as water, minerals, and building materials, is important for military logistics and sustainability during military deployments and operations. Resources assessment is an integral part of military self-sufficiency.

4. Infrastructure planning

   Military geoservices contribute to the planning and construction of military bases, airstrips, and other infrastructure by assessing the geology and soil conditions of potential base sites.

5. Crisis and disaster response

   Geoscientific expertise helps to deal with natural disasters or humanitarian crises by providing geospatial data, which assess the extent of damage, plan relief efforts, and coordinate logistics.

6. Geological hazards

   Identifying and mitigating geological hazards such as landslides, earthquakes, and volcanic eruptions in operational areas is crucial for the safety of military personnel and equipment.

7. Navigation and mapping

   The timely provision of precise geospatial information is the precondition for accurate navigation, mapping and targeting systems used in military operations.

8. Research

   Military geoservices actively contribute to national and international scientific projects in order to close capability gaps in the defence sector and to develop new knowledge.

International military geoservices cover at least one of these tasks but strongly differ in scope and focus. However, military geosciences have played a significant role in modern warfare and defence strategies, although they are hardly mentioned directly in security or defence policy due to their cross-sectional subject matter.

Within the Austrian Armed Forces, the Austrian Institute of Military Geography carries out most of the key tasks of military geosciences, although there is an overlap with other departments and military branches. There is a strong focus on mapping and the visualisation of geoinformation, and the broad spectrum of terrain analysis clearly addresses higher levels of military leadership.

The Austrian Institute of Military Geography is therefore the central contact point for the Austrian Ministry of Defence, its subordinate departments, and state crisis management in all matters relating to analogue and digital geographical data and geoinformation requirements.

Climate change, security and military geosciences

It is common knowledge that the effects of climate change act as an insecurity amplifier, exacerbating existing social, economic, and political tensions especially in vulnerable regions. For example, the ever longer-lasting droughts in the Sahel zone cause serious food and water shortages, which worsen conflicts and accelerate displacement (UNHCR, 2022; UK Parliament Post, 2022). First occurring locally, this scarcity of resources increasingly plays a state-wide and even international role. Especially in regions relying heavily on agriculture, the escalating competition for foodstuffs plays an increasingly destabilising role. Of course, the situation in West Africa and the Middle East regarding the decline in seasonal precipitation is one of the most obvious, but it has also become a serious problem in the South-East Asian and South American regions.

Almost every country in the world experiences an increased number of extreme weather events, which has the potential of disrupting societies and straining emergency response systems even in resilient countries. For example, there is a strong relationship between the increasing number of hurricanes and storm floods, raising national security issues in the USA (GRI, 2022).

However, not only resource scarcity and extreme weather events are responsible for an increasing destabilisation of societies. Due to the melting of the pole ice, the global sea level rises by about 20 cm per year, which creates a new source of conflicts and instability. Nearly 60 percent of the global pop-

ulation live within a radius of 60 km from a coastline, and the danger is acute for some 900 million people (UN, 2023).

While climate change directly or indirectly has primary effects on national and international security, there are also secondary mechanisms. Climate change influences world economics, leading to job losses, increased poverty, and reduced economic stability. This potential instability can, in turn, contribute to security challenges (WBGU, 2007).

Understanding the underlying geoscientific fundamentals of climate change in general allows an earlier detection and possible avoidance of negative effects on security. Military geoservices such as the Austrian Institute of Military Geography deliver geoinformation for ongoing missions, military training and operational planning. Therefore, the relevance of military geosciences will potentially increase.

In order to address security challenges, many countries are incorporating climate change considerations into their national security strategies, thus affecting military policies (e.g. Federal Foreign Office, 2023 or Cabinet Office, 2008). On the one hand, this includes efforts to reduce greenhouse gas emissions to mitigate the impacts of climate change as well as adaptations to military capabilities and workflows. The essential performance of military geoservices could be the identification of the effects of global climate change on local terrain and the consequences for military personnel, equipment and operations.

International political and institutional framework (EU, OSCE, NATO)

Adapting military geoservices to current and future security issues caused by climate change is not (only) a national question. The Austrian Armed Forces act in an international political environment and will therefore most likely be used in multinational frameworks. As a small country, Austria can contribute qualitatively by providing precise and quick geodata during planning and participating in international missions. In the context of the Austrian Security Strategy, three international institutions play a key role for the Austrian Armed Forces and therefore for the Austrian military geoservices (Austrian Security Strategy, 2013): the EU, the OSCE, and NATO.

The European Union (EU)

Climate change poses a significant threat to EU military assets, capabilities, and operations, necessitating adaptations for increased operational effectiveness in the EU defence sector. For Europe, the European Commission highlights the climate-energy-defence connection and proposes actions to enhance climate resilience and energy sustainability in EU defence (European Commission, 2008). Climate change affects all sectors, with severe economic losses recorded in the European economic area between 1980 and 2020. Energy production and distribution are exposed to various climate hazards, while fossil fuels, still part of the energy mix, face climate-related threats (Tavernes Da Costa et al., 2023).

Therefore, the EU recognises the significant security risks associated with climate change and has developed a strategy to address this intersection of climate change and security (European Commission, 2023). In addition, there is an engagement in climate diplomacy to promote international cooperation on climate action on both a political and an economic level. By working with other countries and organisations, the EU aims to prevent and mitigate climate-related security risks.

The EU supports the development of early warning systems that can identify climate-related security risks. This helps anticipate potential conflicts and allows for proactive measures to be taken.

Climate change may lead to resource scarcity, such as water and food shortages, which trigger and intensify regional conflicts. The EU strategies to address these challenges include sustainable resource management and supporting resilience in vulnerable regions. Owing to potential increased migration and displacement as people are forced to leave their homes due to climate-related impacts, the EU provides assistance to those affected (UN General Assembly, 2019).

The EU integrates climate change considerations into its peacebuilding and conflict prevention efforts. It recognises that climate-related factors can contribute to conflict and instability and aims to address these root causes. The focus of the strategy is on cooperation with international partners, including the United Nations, and on coordinating efforts to address climate-related

security risks at a global level. The EU engages with the security sector to ensure that climate change is considered in security planning and operations. The EU's strategy on climate change and security defines climate change as a multi-dimensional challenge that can have far-reaching security implications. By addressing these issues comprehensively, the EU aims to contribute to global stability and resilience in the face of climate-related threats (Lazarou and Tothova, 2022).

The Organization for Security and Co-operation in Europe (OSCE)

The OSCE acknowledges that climate change contributes to conflicts, particularly in regions with limited resources. The approach to climate change and security is rooted in its mandate to promote peace and stability in the Euro-Atlantic and Eurasian regions. Therefore, a strong focus is placed on the importance of early warning systems, international dialogue, and conflict prevention measures to prevent conflicts from arising (OSCE, 2007).

The OSCE promotes sustainable resource management as a means to mitigate potential conflicts that stem from resource scarcity exacerbated by climate change. This includes sharing best practices and supporting capacity building in participating States.

Climate change can lead to more frequent and severe natural disasters. Efforts to reduce disaster risk, including improving preparedness and response mechanisms to reduce the security risks, are just as much part of the strategy as providing assistance and capacity building to OSCE participating States. This may include training, sharing knowledge and best practices in topics related to climate change on a political level.

However, the OSCE also adopts a comprehensive approach to international security that recognises the interconnections between environmental, economic, and social factors. Climate change is considered within this broader context, and efforts are made to address its impacts on overall security. To align efforts in addressing climate change and security at the regional and global levels, there is collaboration with NATO and the European Union focusing on discourse and dialogue events. (Barnhoorn, 2023; OSCE, 2021)

The North Atlantic Treaty Organization (NATO)

NATO conducts risk assessments to identify and analyse the security risks associated with climate change, such as extreme weather events, resource scarcity, and population displacement. Climate change is seen as a "threat multiplier" that exacerbates existing security challenges and increases the intensity of existing conflicts (Farhan et al., 2023).

As the largest global military alliance, NATO has a strong focus on reducing its environmental footprint by incorporating more sustainable practices into its operations and activities. This "greening the military" includes serious efforts to decrease energy consumption and emissions (Barry et al., 2022). In addition, climate change considerations are integrated into military planning processes. This may ensure the minimisation of future climate-related risks and negative impacts on military operations (NATO – OTAN, 2022).

There is also collaboration with the United Nations and the European Union to address the common interests related to climate change and security challenges. For example, NATO promotes the sharing of climate data and information among Member States and partners to improve situational awareness and enhance decision-making.

NATO explores innovative technologies and solutions to enhance its ability to respond to climate-related security threats. The focus is on building resilience within its Member States and partner countries. This includes enhancing the ability to withstand and recover from climate-related disruptions and disasters.

Military relevance for international policies on climate change and security

Environmental damage may justify national or international military intervention, although political or economic sanctions are a more likely response (US Government, 2015; 2021). However, an increasing intensity of extreme climate events could alter public and political attitudes toward military force. Increasing climate instability may require European forces to show an overseas military presence and engage in humanitarian assistance and disaster relief operations. Climate change could therefore lead to a greater emphasis on

armed forces' roles in addressing environmental challenges and security concerns, potentially shifting resources from traditional combat capabilities. European forces may operate in more climate-fragile environments and need to consider the environmental impact of military operations (Berry et al., 2022).

Military challenges and situational awareness

The application of geoscientific methods for military interests purposes the deep understanding of the terrain that surrounds a soldier. Therefore, the methodological framework for analysis is set by the specific mission goal and the level of abstraction, which depends on the recipient of geoinformation. In all cases, the principle "as little as possible but as much as necessary" applies. In this sense, military geosciences are always in the field of tension between scientific accuracy and operational practicability (McNealy et al., 1999).

Due to an increase in complexity, these two poles drift even further apart because of climate change and its negative impact on the environment. This means that one of the most challenging military problems in dealing with environmental topics is the development and application of an appropriate scientific methodology covering the rapid changes of militarily interesting geofactors over time.

To put first things first, however, it is fundamental to become aware of the numerous problems for military personnel, equipment and operations caused by climate change. Embedded in international alliances (e.g. European Union) and organisations (e.g. United Nations), the Austrian military strategic interest focuses on the Balkan region, the Middle East and Western Africa, which are one of the areas most affected by climate change. The most important impacts of climate change on these focus areas are explained below:

Balkans

Like many other parts of the world, the Balkans are experiencing rising temperatures, changes in precipitation patterns, and more frequent extreme weather events. Climate change leads to shifts in rainfall patterns, potentially causing more intense and prolonged droughts or heavy rainfalls, increasing the likelihood of flooding.

The Balkan Peninsula is experiencing higher average temperatures, which lead to more frequent heat waves with negative consequences for agriculture and health. Changes in precipitation affect water resources, such as rivers and lakes, which are vital for local energy production and human nutrition, especially in the southern Balkan regions. On the other hand, heavy rains lead to water quality issues with negative effects on groundwater aquifers.

The most famous disaster was the 2014 flooding in Bosnia and Herzegovina related to Cyclone Tamara. After that, in 2017, the Balkan region was hit by heatwaves and droughts. These crises occurred in a complex post-conflict situation after the collapse of Yugoslavia (IMCCS, 2022).

Middle East

Due to the effects of climate change on the environment, North Africa and the Middle East belong to the most affected regions in the world. These parts of the world are already characterised by their arid and semi-arid climate, water scarcity, and vulnerability to extreme weather events.

Climate change exacerbates this problem by reducing freshwater availability through decreased rainfall and increased evaporation. This leads to more severe droughts, affecting agriculture and access to drinking water. The Middle East experiences higher-than-average temperature increases compared to the global average. Extreme heatwaves are becoming more common, posing health risks and impacting energy demand for cooling.

Coastal areas in the Middle East, including major cities like Cairo and Alexandria, are vulnerable to rising sea levels. This enormously threatens the infrastructure and populations living in low-lying coastal regions. Climate change disrupts traditional agricultural practices in the region. Water scarcity, changing precipitation patterns, and temperature extremes can reduce crop yields and affect food security, exacerbating existing political tensions in the region (CRS, 2023)

During the finalisation of this study, Libya is experiencing one of the most destructive flood disasters in its history. Several dam failures and an overall chaotic situation heavily affect the city of Derna, causing a serious humanitarian crisis. Libya is one of the key countries for cooperation with reference

to migration from the North African region. Therefore, the high risk of the potential negative effects of climate change also has an important security aspect, not only for the European Union or the North African and Middle Eastern countries but also for highly vulnerable population groups located on site. However, there is strong evidence for an increased mobilisation of refugees, asylum seekers, stateless persons and other persons of concern as a result of the negative effects of climate change (The White House, 2021).

Western Africa

The Sahel zone is a semi-arid region in Western and Central Africa that stretches from the Atlantic Ocean to the Red Sea. The beginning of the broad discussion on climate change and international security probably has its origin in the development of terrorism and the worsening environmental conditions in Western Africa.

Climate change contributes particularly to more frequent and severe droughts in the Sahel zone. Reduced rainfall and prolonged dry spells lead to desertification. This threatens rain-fed agriculture and pastoral livelihoods in a region with already harsh conditions (UNHCR, 2022). Crop failures and decreased agricultural productivity cause food shortages and increased insecurity for up to 30 million people, including particularly vulnerable social groups like ethnic minorities, women and children (NEP, UNDP, UN Women, DPPA, 2020).

In addition, water sources in the Sahel zone are heavily under stress due to reduced rainfall and increased evaporation. This affects access to clean drinking water and fuels conflicts over water resources.

Austria

Austria has observed an increase of 2°C in average temperatures since 1880, which is slightly above global average. The number of days with over 30°C and tropical nights has significantly increased. There are more frequent and intense extreme weather events, such as heavy rainfall leading to floods and landslides. The country is known for its beautiful alpine landscapes and glaciers. However, climate change is causing the retreat of glaciers throughout the European Alps.

Austria's security strategy has recognised the growing importance of addressing climate change as a security concern (Austrian Security Strategy, 2013). Rising temperatures, extreme weather events, and resource scarcity can exacerbate conflicts and create instability, both domestically and globally. Climate change exacerbates natural disasters and changes migration patterns. The frequency of disaster relief and humanitarian missions carried out by the Austrian Armed Forces will potentially rise. In addition, climate-change-induced migration, such as people fleeing from areas affected by sea-level rise or extreme weather, can impact border security.

Perspectives of applying military geosciences within the Austrian Armed Forces

Climate change causes and will cause several new military problems. Therefore, every military branch and leader has their own way to adapt to them. From the perspective of the Austrian military geoservices, it is a technological challenge to display fast-changing environments. Of course, this is no isolated military problem but also a geoscientific one. Expressed abstractly, the "terrain" becomes a fast-paced environment, which forces permanent reanalysis. To transport such non-conventional geoinformation, the product range of the military geoservices may be expanded accordingly.

In addition, the occurrence of an increasing number of extreme weather phenomena including their consequences and the potential for extreme forest fires, poses a problem due to the increased need for precise geoinformation. Therefore, rapid map making, and mission geo-support will become increasingly important.

The third future challenge is the potential for more than one critical event caused by climate change that the military will have to react to. There is a risk of losing geoinformation quality due to limited human, logistic and financial resources.

However, climate change has a geographically uneven effect on regions of interest. Probably the biggest challenge will be finding out the mission-specific and relevant geofactors and their influences on the operational readiness of soldiers.

The Austrian Institute of Military Geography strives continually to improve the product portfolio and is aware of the future challenges induced by climate change. The aim is to expand the spectrum and to concentrate military expertise in all geoscientific disciplines with a strong focus on military geology and geoinformatics. In addition, there is active participation in national and international research projects on the subject of effects of climate change on military operations.

Global climate change is one of the most serious problems of humanity. Therefore, minimising its negative effects on the environment and security in parts of the world is of high importance (Green Climate Fund, 2020). This study may give an idea of the future challenges of the Austrian military geoservices in the context of contributing to military operations and contributes to a better understanding of this "exotic" military branch. There are new challenges and tasks, but the Austrian military geoservices are ready to aid in minimising the negative effects of climate change on the Austrian Armed Forces.

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Climate Crisis and Security on a Large and Small Scale: The Role of Civil Society

Agnes Zauner

Emphasizing the crucial importance dealing with climate change on a global and local level to prevent global security issues, the text highlights the important role of civil society, especially environmental groups, in addressing security concerns. In this regard the impact of climate change on economies, supply chains, and social stability is discussed, urging cooperation between governments and civil society for a sustainable change. The text also looks at potential security challenges from climate-related problems and stresses the need to follow the rule of law. Additionally, civil society groups can strengthen security through community teamwork, sharing resources, and resolving conflicts. In conclusion examples illustrate how environmental groups and the military can work together to address climate issues and improve security.

Introduction

In 2023, extreme weather events again hit many places around the world. This would not occur in such numbers and intensity without the advancing climate crisis. In Canada, forests burned from June to September, leaving a devastated area of more than 160,000 km² (Eisenberg et. al., 2023), which is the area of Austria and the Czech Republic combined.

From India to Vietnam, there were countless unprecedented heat waves in 2023, and the Mediterranean region experienced heavy rain, tidal waves and flooding. These are just some of the weather extremes that broke records in 2023 alone. The bad news is: It is not going to get better. The good news is: It will not get much worse if humanity intervenes.

If we continue down the fossil-fuel- and resource-exploiting economic path, we are heading for the ecological tipping points, the consequences of which will put our civilisation in its current form under heavy pressure (Potsdam Institut für Klimafolgenforschung, 2023). The international community will

face massive problems, first and foremost security problems. If the supply chains of the globalised world at their end no longer spit out the goods that are sold (especially in the Global North), there will be huge economic losses – unless a **restructuring of the economy to a system that works within planetary boundaries** is achieved by then. Should this not be the case and the economy and thus jobs, sources of income and access to essential goods become massively scarce or dry up, the first social discord will occur. If vital resources such as drinking water or fertile farmland are also threatened, entire regions will face a massive security problem. This is already a reality in several regions of the world, such as around Lake Chad, which is severely affected by climate change (Kamta, 2020). Conflicts over scarce resources can shake the internal stability of countries and lead to violent clashes along ethnic or religious lines.

Security as a civil society issue

Security for people in the way we are organised (in states, regions, municipalities, communities) is a civil society issue to the core. Although the issue of security is first and foremost located at the state and supranational level, which has an advantage for organising security agendas (armed forces, intelligence services, the police, justice system, and prison regime, international organisations, services of general interest, etc.), security is carried out by civil society organisations on a large scale: volunteer fire brigades, civil defence associations, countless organisations in the field of violence prevention, women's shelters, child protection institutions, social and human rights organisations, to name just a few areas. A more recent idea is that environmental protection organisations also deal with the issue of security. With the daily task of debunking and exposing pollution and greenwashing, advocating for laws to protect the environment and implementing projects to preserve nature and biodiversity, the ever-worsening situation of climate and biodiversity raises the question of what happens when the tipping points are reached, ecosystems as we know and need them no longer function and natural disasters increase. As described above, the consequences of a lack of climate and environmental protection are a security risk for communities, states and all continents.

So everything for humanity depends on whether we can stop the climate from heating up. At the moment, it looks like it is going to get worse for a while, even if we manage to change course. Even if we stop all carbon emis-

sions today, the climate crisis will have a long-term impact. For example, the sea level will continue to rise for centuries (IPCC, 2023). Either way, big changes are needed for people and society, if they are made now, we have a chance of a society that is inclusive, can reduce resentment through fairness and functions within planetary boundaries. This goal can only be achieved if governmental as well as civil society organisations work together and actively support society in this great transformation. Part of this is also to prepare for the fact that, as it looks now, our climate will continue to deteriorate for quite some time.

On a large and small scale

Science currently predicts a global average warming of about +2.9°C (Climate Action Tracker, 2023; IPCC, 2023; UNEP, 2023) with existing policies and actions. If the international community fails to reduce its greenhouse gas emissions, a much higher temperature rise is possible. First and foremost, the industrialised countries are obliged to act. A +2.9°C scenario would be a catastrophic situation for humanity – it would affect all people around the world, not to mention ecosystems with all their fauna and flora. **This scenario must be prevented by all means**, by each individual state and especially the states with the currently and historically highest greenhouse gas emissions: by reducing them as quickly as possible. Climate targets for emission reduction (in different efficiency) exist in the majority of these states (Net Zero Tracker, 2023), but they fall short of what is necessary. As the UNEP Emissions Gap Report shows there are excess emissions of 23 Gt CO_2e by 2030 for a 1.5°C pathway. There is also a substantial 'implementation gap' highlighted by the UNEP emissions gap report (UNEP, 2022). The G20 members alone fall short of delivering their nationally determined contributions (NDC) by 2.6 bn tonnes of CO_2 by 2030. So, the gap can be partly closed by actually implementing what has already been promised.

There are, of course, different scenarios for different parts of the world. Before swathes of land dry out completely, sufficient food supplies are no longer possible in many areas and people are forced to leave their homes in large parts of the world (as is already the case in many regions), the climate crisis will have a massive impact on our economy. Taking Europe as an example, it will probably massively affect the supply of food from Italy, Spain and the entire Mediterranean region (Lange, 2020). If the economy as we

know it in Europe, and which our individual lives are based on, partially or completely collapses due to supply chains that no longer function, social and political questions will have to be asked. Ideally before that happens, ideally now.

In doing so, it is important to think on a large and small scale. Take the pyramid of Needs (Landeszentrale für Politische Bildung Baden Württemberg, Fachbereich Jugend und Politik, 2017) as a starting point, in which the basic needs, such as food, drink and sleep, are immediately followed by individual security needs. In a changing world, these needs are actually or perceived to be under pressure. This can be exploited by populist and antidemocratic parties or movements to divide society and secure support for simple answers that are supposed to restore the sense of security (Bayerlein & Metten, 2023). In the process, there is always a scapegoat to blame. In the worst case, rising popularity of these antidemocratic and populist parties and movements culminates in the undermining of the rule of law. Such a scenario is also possible in a climate scenario that massively restricts people's lives and thus curtails their need for security. Safeguarding the rule of law must be the top priority in a state's strategic security planning. The changes brought about by the climate and biodiversity crises will have a massive impact on this.

If the rule of law is eroded, the essential question is: If the state can no longer guarantee the security of most of its inhabitants, how do you organise communities on a small scale so that their security needs are met? Let's assume that in a country the food supply through supermarkets no longer exists, you can no longer work in the supermarket or many other industries to earn money, but for example, you have a piece of land where you can grow potatoes. What is the point in having a potato field with enough fertile soil and water (and pollinating insects) if you do not have a rule of law that guarantees that your land will continue to be yours so that you can dispose of the food planted on it? We should probably have to look at other countries and regions where this situation is already a reality. People will find their gaps and niches, but it will not work out for everyone.

In situations where the rule of law is not functioning properly, different factors and capabilities are crucial to ensure the security of a community. Organised civil society and its impact from small to large plays an important role in such a scenario as well as in prevention:

Community cooperation and solidarity are an important precondition to prevent the erosion of the sense of security and the rule of law. A strong community that sticks together and where individuals support each other is more resilient to populism and extremist movements (Boeri et. al., 2018). Community spirit and solidarity can help to ensure the security of the members of a society and also in communities (villages, neighbourhoods, homes, family). This is supported by civil society organisations. Shared commitment and personal relationships are the origin of trust, solidarity, respect and cohesion.

Local governance structures and local self-organisation are also important to lead the community, make decisions and use resources effectively. There is an encouraging trend right now towards energy communities at a very local level. People on the community level are joining together to generate and purchase their electricity collectively. This model has already celebrated some success (Sansom, 2023) and will be the future of energy supply. (Nevertheless, there must be state structures to ensure the technical supply with supra-regional grids). At the moment, it is mainly civil society organisations and start-ups that are tackling this issue of energy communities.

Numerous NGOs and civil society organisations are also working on **how resources are distributed** and who has access to them: The efficient use and distribution of limited resources such as food, water, medicine and other essentials is crucial for community survival. Today, the foundations for this are being laid when organisations that have made the fair distribution of resources their mission are successful. The questions of who has access to sufficient basic needs and the needs for social participation are at the centre of this. Of course, this is also about the question of poverty and wealth as well as the distribution of paid and unpaid work in a society.

If life is to be organised more locally, **communication and information exchange** between communities and society as a whole is essential in order to find out about threats to security in good time. Effective communication is essential to coordinate emergency plans and keep the community informed. This is where an organised state comes into play, but also other actors who disseminate information. Civil society organisations and organised communities also have a role to play here: Trust in information coming from people you trust is particularly high (Statista, 2017). The community should also be well prepared to respond to natural disasters, conflicts or other crisis

situations. This includes developing emergency plans and conducting regular exercises. Here, there is a need in society for government security institutions to train and educate people already.

An important basic need is **health care and first aid**. Basic first aid skills are already being taught by civil society organisations. On the one hand, access to health care is essential and must be ensured as much as possible, even in a society that no longer lives by normative laws and rules we have in today's Europe. There will have to be access to medical knowledge on the one hand and access to technologies on the other. Cooperation between the state and civil society on this issue in preparation for what the climate scenarios say is coming will be essential for the security of our society.

Even in small-scale organised societies there are conflicts. Here, **conflict resolution and mediation** are a central task that must be established in a community. The ability to resolve conflicts peacefully within the community is crucial to reduce tensions and ensure the security of all members. Here we can learn a lot from violence prevention centres, mediators and victim protection institutions. Societies need to uphold laws and human rights, so the rule of law as an overarching institution is essential.

What **education and skills** will we need to survive in a 2-3°C hotter world? Community members should have the necessary skills and knowledge to take care of themselves and minimise possible dangers. These can be very different skills depending on the circumstances. Those mentioned above, such as thinking and acting in community and solidarity, are essential in any case. It could be agricultural and manual skills, as well as psycho-social and caring skills, and other practical skills that ensure life and survival in an insecure world. On the one hand, upgrading craft and care professions in our society would be an important step; another step would be a different organisation of gainful employment towards more time for voluntary engagement and community work, in which care work in families, among friends, among neighbours as well as craft and agricultural skills often play a greater role than in a job. People in civil society get involved in clubs and other associations to run community gardens and food sharing, to build a house together, to take care of the elderly. This requires time and resources. We can also invest in these right now by giving this kind of work a much higher priority and enabling people to have a good life away from 40 hours of gainful employment.

These security-related areas, with no guarantee of completeness, would also be important parameters for a prosperous and secure development of society in a future scenario in which humanity is not heading for a climate catastrophe. However, at the moment we are in this scenario, and it is essential - and this is the most important statement in this text – to **prevent the climate catastrophe at all costs**! Society and politics cannot avoid developing long-term strategies to preserve resources, protect the environment and the climate and create the transformation to a sustainable way of life.

Politicians have the task of creating and implementing laws on climate and environmental protection based on the scientific facts, and the economy needs these laws to provide planning security and to steer innovation and economic development in a sustainable direction. The security institutions such as the military and the police have the task to think strategically about security scenarios and to develop plans together with science to strengthen society with regard to threat scenarios. In all this, it is advisable and even essential to involve civil society. Whether in citizens' councils such as the Climate Council in Austria or in cooperation with NGOs, successful strategic planning for the future will depend on the good cooperation and political will of these institutions.

Examples of cooperation between an environmental NGO and the military

A cooperation between an environmental protection organisation or initiative and the military may seem unusual at first glance, but there are certainly ways in which they can jointly contribute to environmental and climate protection. Even though most environmental organisations and initiatives are rooted in the peace movement of the 1970s, which rejected large aspects of state armed forces, the world has changed and the environmental movement in large parts also recognises the importance of exchanging ideas with different institutions and, if it is beneficial to the cause, to cooperate. Like in every cooperation, an NGO must always be extremely careful not to be tokenised, nor to be used for greenwashing!

In general, the following are possible areas where environmental organisations and the military can achieve mutual advancement in climate protection issues:

At global scale, the military accounts for 5.5% of global CO_2-emissions according to experts' estimates. Despite this, they are almost always excluded from climate protection plans and targets (Scientists for Global Responsibility, Conflict and Environment Observatory, 2022). If the military takes a **pioneering role in climate neutrality**, this has several advantages: On the one hand, it increases the pressure on other, especially governmental, institutions to take climate action, and on the other hand, it makes the armed forces more resilient if they are no longer dependent on fossil fuels. Of course, care must be taken here to also minimise dependence on complex global supply chains. The military can invest in renewable energies, self-sufficient emission-free energy production and promote the use of energy-efficient technologies. This could include installing solar energy systems on military bases, using wind power or switching to lower-emission means of transport. Sufficiency – the question of how much is really needed – plays a crucial role here. As in all areas, the ultimate goal must be **energy savings**!

The military usually has considerable research resources at its disposal. Cooperation with an environmental organisation could bring **development and promotion of environmentally friendly technologies and innovations**, including those that benefit civil society and communities – keyword: energy self-sufficiency.

The military and its research institutions are the key actors for **analysing security risks** caused by the climate and biodiversity crisis and their impact on national and international security. Better access to and exchange of data between the military and NGOs can bring immense benefits to both sides. On the one hand, the environmental organisations can use these data to better support their own demands towards policy-makers and, on the other hand, they can contribute new aspects to these assessments and analyses with their knowledge of civil society and their expertise in the field of environment. This could include the identification of conflict hotspots within environmental and climate issues such as water scarcity or food insecurity.

The issue of **training and awareness-raising** could also work both ways in a cooperation between the military and civil society environmental organisations: Through cooperation, the military could better raise awareness within civil society regarding the security issues that the climate crisis entails. At the same time, it could use the expertise of an environmental protection organi-

sation in its own training courses. Young people in particular are very interested in climate and environmental protection. To reach this group in both civil society and the military, cooperation could make a difference.

A military aware of climate issues can contribute to more effective climate protection at the political level with its advisory function. Being able to draw on the experience and needs of civil society can prove to be an advantage for a comprehensive view of this highly relevant security policy issue. The sharpened view of civil society would also be an advantage in the course of exchanges with other states at the diplomatic level.

In a cooperation between a political civil society organisation, as environmental protection organisations usually are, and the military, it is important that such a cooperation is based on mutual respect, trust, clear goals and transparent communication. Both parties should bring their respective strengths and resources to bear in order to contribute effectively to climate protection together.

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Mine Action and Climate Change: The Legacy of Explosive Ordnance Contamination and Future Needs

Kristin Holme Obrestad, Linsey Cottrell, Sarah Njeri

Land contaminated by landmines and other explosive remnants of war poses a significant and long-term threat to communities living in conflict or post-conflict areas. These threats are exacerbated due to regional vulnerabilities to climate change and environmental degradation; this is particularly the case with communities that rely on agriculture. However, there are opportunities to mitigate these negative impacts and to support the climate resilience of communities through co-ordinated mine clearance activities, locally led climate adaptation and environmental initiatives.

Areas contaminated with landmine and other explosive ordnance include ecologically sensitive and important natural habitats. (Credit: Norwegian People's Aid)

Mine action – a global perspective and the OSCE

Anti-personnel mines and other explosive ordnance (EO) kill or injure thousands of people each year. EO includes conventional landmines and landmines of an improvised nature, cluster munitions remnants, and other explosive ordnance that may remain in the ground for decades and prevent a community's safe access to land, local resources and livelihood assets (Cottrell & Dupuy, 2020a).

Globally, an estimated 60 million people live in areas affected by, and facing, the dangers and indirect consequences caused by landmines and other explosive ordnance (Global Protection Cluster, 2021). On average, 10,000 people are killed, injured or traumatised each year by explosive remnants of war, with mine action operators playing a vital role in supporting local communities. In 2021, at least 5,544 people were killed or injured, with children accounting for half of all civilian casualties – where the age was known – and with men and boys making up the majority (81%) of all casualties (ICBL-CMC, 2022a). Mine action operators remove EO to make areas safe for people to use, together with international humanitarian mine action (HMA) organisations – such as DanChurchAid (DCA), the Foundation Suisse de Déminage (FSD), the International Committee for the Red Cross (ICRC), Norwegian People's Aid (NPA), the Mines Advisory Group (MAG) and The HALO Trust – as well as national demining operators, civil protection and the military (ICBL-CMC, 2022a). In some regions – for example Kyrgyzstan, the Russian Federation or Uzbekistan – there are no national mine action programmes, and all mine clearance activities are carried out by the military (Mine Action Review [MAR], 2022d; MAR, 2022e; MAR, 2022g).

Demining may involve the removal of vegetation and the use and deployment of heavy machinery, which can cause adverse environmental effects, if not properly managed. (Credit: Norwegian People's Aid)

In 2021, donors and affected states contributed US$ 598.9 million to mine action (ICBL-CMC, 2022a). A large part of international mine action assistance comes from a handful of donors, with the five largest donors – the US, Germany, Japan, the UK, and the EU – accounting for 70 percent of all international support in 2021 (see Table 1). Total expenditures on mine action, however, have dropped by around 14 percent since 2017. Donors fund HMA programmes across the globe, and several OSCE participating States remain directly affected by contamination from anti-personnel mines, cluster munition remains or other EO. Of the OSCE participating States, Ukraine, Türkiye, and Bosnia and Herzegovina (BA) were among the highest recipients of mine action support and globally in the top twelve (see Table 2) (ICBL-CMC, 2022a). In 2021, the top five global recipients of mine action support were Iraq, Lao PDR, Afghanistan, Cambodia and Colombia. Since

Russia has been waging war on Ukraine, mine action funding for Ukraine has increased significantly, with the US alone announcing a further US$ 47.6 million as a part of an overall US$ 91.5 million demining project (US Department of State, 2022). The OSCE also announced an extra-budgetary support programme for Ukraine, which includes demining and improving disaster risk reduction (OSCE, 2022).

Table 1 – Mine action contributions by donors, 2017-2021
(table from the ICBL-CMC Landmine Monitor 2022(a) report)

	Contribution – US$ millions					
Donor	**2021**	**2020**	**2019**	**2018**	**2017**	**TOTAL**
US	194.5	204.8	177.4	201.7	320.6	**1,099.0**
Germany	64.8	54.3	38.6	42.5	84.4	**284.6**
Japan*	42.3	39.8	36.9	37.2	32.5	**188.7**
UK	38.2	32.3	71.7	58.1	26.7	**227.0**
EU	37.8	89.8	76.0	108.1	67.6	**379.3**
Norway	35.5	37.4	43.0	47.7	39.2	**202.8**
Netherlands	21.5	12.7	14.9	19.4	19.2	**87.7**
Canada	16.3	8.4	8.7	11.3	10.9	**55.6**
Switzerland	15.2	15.4	14.8	15.0	19.5	**79.9**
Denmark	14.8	13.8	17.6	23.4	15.5	**85.1**
Sweden	4.3	9.1	8.8	18.6	5.2	**56.0**
New Zealand	9.9	8.1	9.1	9.2	5.4	**41.7**
France	9.6	8.5	5.3	12.7	11.9	**48.0**
Italy	5.4	4.8	5.1	4.3	3.9	**23.5**
Australia*	4.4	6.5	10.8	7.8	4.0	**33.5**
Finland	3.7	3.3	3.4	3.2	3.3	**16.9**
Ireland	3.7	3.8	3.7	3.9	1.8	**16.9**
Belgium	3.5	4.5	4.3	3.3	0.9	**16.5**
Austria	3.5	2.3	2.0	1.8	1.2	**10.8**
Luxembourg	1.5	1.3	1.3	1.4	1.4	**6.9**
Others	3.1	4.3	7.9	12.0	21.2	**48.5**
Total	**543.5**	**562.2**	**561.3**	**642.6**	**696.3**	**3,008.9**

Bold denotes OSCE participating States
* denotes OSCE Partners for Co-operation

Table 2 – Top 22 recipients of international support in 2021
(table from the ICBL-CMC Landmine Monitor 2022(a) report)

Recipient	Amount US$ millions	Recipient	Amount US$ millions
Iraq	95.5	**Türkiye**	11.2
Lao PDR	53.8	Libya	10.0
Afghanistan*	49.5	**BA**	9.6
Cambodia	37.3	Angola	9.5
Colombia	31.4	Zimbabwe	8.8
Syria	24.2	Somalia	8.6
Vietnam	21.4	Yemen	8.4
Ukraine	21.2	**Croatia**	6.5
Sri Lanka	18.0	Myanmar	6.1
Lebanon	13.2	**Tajikistan**	4.3
South Sudan	12.0	DRC	4.0

Bold denotes OSCE participating States
* denotes an OSCE Partner for Co-operation

Data certainty varies, and in some cases, the extent of contamination within an affected state remains unknown. OSCE participating States, for example, still do not know the precise extent of contamination with anti-personnel mines in Azerbaijan but consider it to be significant. This is the case primarily along the former Line of Contact between forces from Armenia and Azerbaijan, which extends for 254 kilometres and varies between three and seven kilometres in width and lies in areas previously occupied by Armenia but retaken by Azerbaijan during the 2020 conflict (MAR, 2022b, MAR, 2022a). Türkiye reported around 140 square kilometres of mined areas in 2021, predominantly located along the border with Syria (MAR, 2022f). Before the war in Ukraine, BA was classified as one of the most heavily mined countries in Europe, with the BA Mine Action Centre (BHMAC) reporting that around 922 km^2 were contaminated as of January 2022 (MAR, 2022c).

In Ukraine, estimates regarding explosive ordnance (EO) contamination following Russia's 2022 invasion remain unclear, yet it is considered to be among the most mined countries in the world (UNDP, 2023). The extent of

pre-existing UXO contamination from both World Wars and the 2014 conflict in the east of Ukraine is also unclear (ICBL-CMC, 2022b), although preliminary estimates specify the affected area to cover 7,000 square kilometres (ICBL-CMC, 2018). The reckless attacks on the Nova Kakhovka dam and the smaller Mokri Yaly dam in June 2023 have also aggravated this uncertainty because of the devastating floods they caused, which severely complicate mine clearance activities and produce the risk of moving EO (ACAPS, 2023; RFI, 2023). Overall, approximately 700 square kilometres from the Nova Kakhovka dam to the Dnieper River mouth have been impacted by floodwaters. The flood affected Khersonskyi district is reported to be one of the most severely mined in Ukraine (OCHA, 2023). As a part of both short-term and long-term planning for tackling EO contamination, flooding due to climate change as well as other climate-related impacts must be considered.

Climate change will present additional challenges for all countries affected by EO in terms of both how mine action operations are carried out and the way that EO-contaminated areas and communities will be affected. Climate change will affect OSCE sub-regions differently, depending on shifting weather patterns, extreme weather conditions, climate resilience and any coping or national adaptation strategies in place. For mine action, this may require prioritising certain areas that are prone to flooding, landslides or landscape fires, or other forward planning on clearance techniques or the equipment used in the process. People living in communities affected by EO contamination may also be less able to adapt to, or withstand, climate trends or shocks.

A red sign that reads "Mine Field" sits on the shore of river Sava near the Bosnian town of Orasje during the massive flood in 2014. Flooding and other extreme weather incidents can move landmines and can require re-survey of mined areas and emergency disposals of unexploded ordnances. (Credit: AP/Amel Emric)

Similarly, climate change is also predicted to increase the risks for the marine environment caused by the global problem of sea-dumped munitions. Most sea-dumped munitions originate from the large-scale dumping activities after World War II.[1] Rising sea temperatures, increased seawater acidity and higher frequency and intensity of extreme weather events, including storms, are all factors that could accelerate the corrosion rates of munition casings and the leakage of toxic munitions components (Scharsack et al., 2021).

Climatic impacts and vulnerabilities of states affected by conflict

Climate change does not only complicate mine action activities, but also burdens local resources. It may force different patterns of behaviour to be adopted, people to move and resettle, and land-use to be limited. An understanding of how climate change will affect EO contaminated areas and mine

[1] See https://legacy.amucad.org/map.

action activities is required, exactly as knowledge of the climatic impacts that communities have to expect, the uncertainties involved, and the measures needed to ensure that climatic risks are not exacerbated.

The effects of climate change are wide-ranging and can lead to more intense rainfall, increased risk of floods and landslides, more frequent and intense dry spells, higher average temperatures, increased risk of wildfires, warming oceans, rising sea-level, and thawing permafrost (Cottrell & Stowe, 2021). The implications for mine action are therefore broad.

Mine action activities, such as demining, may include the removal of vegetation, the use of heavy machinery, the detonation or disposal of large quantities of explosives and the generation of hazardous and non-hazardous waste – all of which have the potential to result in adverse environmental effects if they are not properly conducted (Cottrell & Dupuy, 2020b; 2020a). How the land is used after demining could have great influence on the environment and our climate. This means that it is important to ensure that sustainable land use practices are championed, including embedding climate adaptation measures, which could benefit local communities and support nature.

A country's vulnerability and ability to adapt to climate change also varies. Across OSCE participating States, countries with known or suspected high levels of EO contamination – such as Azerbaijan, BA, and Ukraine – score lower on the ND-GAIN index[2] than most other OSCE participating States. The ND-GAIN index summarises a country's vulnerability and readiness to support climate change based on 45 indicators.[3] Ukraine's ND-GAIN index indicates that although climate adaptation challenges exist, the country is well positioned to adapt. However, the index-score pre-dates Ukraine's invasion by Russia. Tajikistan's ND-GAIN index, for example, also indicates that climatic vulnerabilities are manageable, but improvements in readiness will better support the adaptation needs for future challenges. Iraq, which receives the highest mine action support in the world, scores poorly under the ND-GAIN index, ranking 120th out of 182. Iraq has a high climate vulnerability and a low readiness to adapt, with water resources and agriculture being identified as key weaknesses.

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[2] See https://gain.nd.edu/our-work/country-index/rankings/.

[3] ND-GAIN stands for 'Notre Dame Global Adaptation Initiative' and is compiled by researchers at the University of Notre Dame.

Other countries that receive international mine action funding and have a long legacy of EO contamination – such as Afghanistan, Angola, Cambodia, Colombia, Lao People's Democratic Republic (Lao PDR), and Vietnam – also experience the combined adverse effects of climate change and high levels of deforestation. Globally, the rate of deforestation is declining, but still recorded at ten million hectares lost each year in 2015-2020 (FAO, 2022). Tree cover and forests provide multiple environmental mitigation benefits, whereas tree and vegetation loss exacerbates the effects of climate change. Heavy rainfall on bare or sparsely vegetated slopes can cause flash floods since the ground has minimal capacity to retain water. Floods cannot only devastate farmland and directly destroy crops, but can also erode the soil, which can reduce soil productivity in the long-term and further impact food security.

Soil is a precious resource, vulnerable either from the conflict itself or from demining activities. Explosive ordnance can damage vegetation and cause soil degradation, chemical contamination and compaction when it explodes, consequently destroying the soil structure, reducing soil stability and reducing soil fertility (MAR, 2021). The use of mechanical demining equipment or the destruction of munitions can also damage soils and cause compaction. Degraded soils lose their capacity to store water, nutrients and carbon, as well as the capability to support important soil microbes, thus weakening its ability to support growing crops or the wider ecosystem (Bach et al., 2022).

While many human activities degrade soil – e.g. intense agriculture, deforestation, overgrazing and loss of cover vegetation – conflict-ridden areas are typically highly vulnerable because of various factors, including pressure caused by the displacement of people and their impact on natural resources (Bach et al., 2022). In Syria, change of vegetation and soil erosion are among the most serious environmental issues associated with the conflict (Abdo, 2018). Even at the local level and for land use practices after demining activities, the protection and recovery of soils must be considered. This could include the need for support in adopting more sustainable land use practices, forest management or alternative farming models.

In Germany, Slovenia, and pre-2022 Ukraine, the ability of firefighters to tackle landscape wildfires has been severely inhibited in EO-contaminated areas (Connolly, 2022; Zitser, 2022; Varenikova, 2020). Landscape fires also

affect the soil by burning near-surface organic matter, causing the loss of certain nutrients, killing soil microbes and exposing bare ground. For Ukraine, landscape fires larger than one hectare are estimated to have increased in 2022 by thirty-six times as compared to the pre-war period, and soil erosion was identified as a national concern (de Klerk et al., 2023). In 2020, an estimated 57.5% of agriculture was subject to erosion and forecast to increase (Institute of Soil Protection of Ukraine, 2020). Ongoing demining and EO clearance activities must therefore minimise the impact on, and damage to, soils and the wider environment, avoiding rapid or improvised clearance techniques when possible (Focus, 2023).

A new momentum for change?

There is increased momentum on taking practical steps to improve environmental benefits across mine action. The plenary sessions of this year's intersessional meetings for the Anti-Personnel Mine Ban Convention (APMBC) (Anti-Personnel Mine Ban Convention Implementation Support Unit, 2023) and the 26th International Meeting of Mine Action National Directors and United Nations Advisers (NDM-UN26, 2023) addressed the environmental matters and climate change. This included contributions from the United States – the largest single donor to mine action – and the Director of the State Department's Bureau of Political-Military Affairs and Office of Weapons Removal and Abatement (PM/WRA). The PM/WRA has also commissioned a climate study to identify and analyse the best measures for mine action to support efforts in climate change resilience in the future. The study features case study countries – including Palau, Vietnam, Tajikistan, Kosovo, Colombia, Somaliland, Yemen and Ukraine – and is due for publication towards the end of 2023.[4]

The International Mine Action Standard (IMAS) on environmental management (IMAS 07.13) serves as a key guide for National Mine Action Authorities (NMAAs), seeking to develop environmental strategies for their respective national mine action programs (UN Mine Action Service, 2017). IMAS 07.13 is under review, and updates will incorporate climate risks. IMAS 07.13

[4] As announced at the 26th NDM, Geneva International Centre for Humanitarian Demining (GICHD) has been commissioned to deliver the PM/WRA climate study report.

outlines the importance of establishing, reviewing, and maintaining an environmental policy that aligns with national and international legislations. NMAAs are expected to define and communicate environmental obligations through national mine action standards (NMAS) and the respective national mine action strategy. This highlights the need for more states to adopt and integrate climate and environmental management principles within their mine action frameworks to improve environmental protection as a part of mine action and demining operations.

However, to date only a few states have adopted specific environmental management principles within their mine action frameworks (MAR, 2021). Of the OSCE countries, only Croatia has embedded environmental protection measures in its 2015 act. The Ministry of the Interior is conceived as a competent ministry in terms of environmental protection and drafts a National Mine Action Programme and annual Mine Action Plan. Other national bodies, such as the Ministry of Economy and Sustainable Development, include specific protection measures in their preliminary demining plans, based on environmental surveys and approval processes (MAR, 2021, p.14).

Although the environment is not explicitly addressed, Tajikistan's 2017-2020 national mine action strategy acknowledges the potential consequences of natural disasters and risk from displaced mines (National Strategy of the Republic of Tajikistan on Humanitarian Mine Action for 2017-2020, n.d.). In Tajikistan's mountainous areas – where mines were typically dropped by helicopter, heavy rain and snowmelt transport mines down slopes and into areas where they are not expected. This uncertainty highlights the need for continued efforts in mine action and the importance of addressing the potential risks posed by displaced mines resulting from natural disasters, extreme weather events and other climate change impacts, such as landslides. The recording or reporting of these events is not yet standardised but will be necessary as they become more frequent as climate change progresses. The impact of severe floods on mine action in Bosnia and Herzegovina, Croatia, and Serbia has already been well-documented (Orahovac, 2014; Bajic et al., 2015). It is important that practical and emergency measures learnt from tackling the impacts of the catastrophic floods caused by the destruction of the Nova Kakhovka dam are shared so as to enhance future climate change related responses.

For countries in which the NMAA has still to develop fully or in which a set of national mine action standards concerning the environment needs to be adopted, the use of guidance – such IMAS 07.13, which is to be updated shortly – to establish a framework for environmental management as well as climate risks management and climate adaptation should be prioritised.[5]

Mine action faces challenges in Tajikistan's mountainous areas, where heavy rain and snowmelt can transport mines down slopes. (Credit: Norwegian People's Aid)

[5] Detailed guidance is provided in ISO 14090 (2019) Adaptation to climate change - Principles, requirements and guidelines and ISO 14091 (2021) Adaptation to climate change – Guidelines on vulnerability, impacts and risk assessment, both available at https://www.iso.org/.

How is the environment addressed in international disarmament treaties?

The APMBC,[6] according to which state parties commit to not develop, produce, acquire, stockpile or use anti-personnel mines, and to ensure that mined areas within their territory are cleared, is a disarmament treaty signed by more than 80 per cent of the world's countries. Similarly, the Convention on Cluster Munitions (CCM) prohibits all use, production, transfer and stockpiling of cluster munitions and, in addition, requires clearance of contaminated areas.[7] Environmental considerations are addressed differently in both treaties; yet, both require state parties to include information on the environmental implications when they apply for an extension of their respective deadlines for clearing areas contaminated by anti-personnel mines and cluster munitions, as well as transparency measures for applicable safety and environmental standards.

Beyond that, the Lausanne Action Plan (LAP) lays out actions and good practices for states with regard to their implementation of the CCM, including several actions that are aimed to improve environmental protection measures (Convention on Cluster Munitions, 2008). The LAP also advocates research and development into innovative survey and clearance methodologies, which consider environmental effects and concerns, actions aimed at furthering the sharing of good practices and lessons learnt on environmental impact assessments and on incorporating environmental protection considerations. Action 30 of the LAP calls for risk education initiatives to take into account risks caused by changing climatic and environmental conditions. Although the activities set forth in the Action Plan are not legally binding, an indicator or indicators to monitor progress and identify challenges in their implementation accompany each action. While the LAP is explicit and identifies environmental concerns as a cross-sectional matter, the five-year Oslo Action Plan supporting the implementation of the APMBC does not mention the environment (APMBC Review Conference, 2019). Revisions of the Oslo Action Plan are planned for 2024.

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[6] Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction, Oslo, 18 September 1997 (entered into force 1 March 1999) (Mine Ban Treaty).

[7] Convention on Cluster Munitions, Dublin, 30 May 2008 (entered into force on 1 August 2010).

Expectations and progress across the wider humanitarian sector

The broader humanitarian sector has already begun to address climate change and integrate environmental considerations into their operations. In 2014, the United Nations UNEP/OCHA Joint Environment Unit established the Environment and Humanitarian Action (EHA) network to promote environmentally responsible humanitarian programmes. The ICRC has also been actively working to embed environmental practices in their operations and, together with IFRC, launched the *Climate and Environment Charter for Humanitarian Organisations* (ICRC & IFRC, n.d.). The charter emphasises the need to adapt humanitarian aid to address the impacts of climate change and environmental crises and includes seven commitments that reduce the environmental impact of humanitarian activities. The ICRC itself has set organisational targets, including the reduction of its greenhouse gas emissions by at least 50% by 2030, and strengthening awareness, understanding, and the implementation of International Humanitarian Law (IHL) with regard to environmental protection among states and parties involved in conflicts.

Such initiatives demonstrate the humanitarian sector's recognition of the need to take concrete action to mitigate the environmental consequences of humanitarian operations and build resilience. Enhancing resilience and reducing poverty are among the goals of the UNDP mine action programs, which call for integrating mine action and long-term development processes in crisis and post-crisis settings as an avenue of addressing these critical factors. Humanitarian mine action offers the opportunity to support more sustainable future land-use practices and helps deliver climate resilience and long-term environmental benefits.

In October 2020, the European Commission's Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG ECHO) released its approach to reducing the environmental footprint of humanitarian aid (European Commission, Directorate-General for European Civil Protection and Humanitarian Aid Operations [ECHO], 2020). HMA organisations as a part of the humanitarian aid sector are encouraged to adopt the 'do no harm' principle and adopt a precautionary approach and apply mitigating measures to reduce potential negative environmental impacts. To support relevant organisations, DG ECHO launched project-level minimum environmental requirements for partners, covering key priority areas and aiming

to reduce the impact of EU funded humanitarian operations on local ecosystems (ECHO, 2022a). The DG ECHO expects these measures to be reflected in project proposals, with the issued guidance encouraging a holistic approach when designing and implementing actions (ECHO, 2022b), and ensuring that activities are planned and modified as required. Similarly, guidance calls for minimum environmental requirements to complement national laws and regulations including environmental laws and regulations of the wider context where programs are being implemented. Few mine action organisations currently receive DG ECHO funding, yet this reflects the general ambition of donors and the need for humanitarian organisation to embed these environmental requirements as a minimum demand (ECHO, 2022b; ECHO 2020).

Nature-based solutions (NbS) and other positive action to support climate resilience

In partnership with environmental stakeholders, mine action activities can directly support more sustainable future land-use practices and community climate adaptation. Land contaminated with explosive ordnance frequently includes areas that are agriculturally important or rich in biodiversity, with HMA often operating areas that are vulnerable to climate and with insufficient climate adaptation and climate financing. In Ukraine, the estimates of the agricultural areas affected by munitions and military debris vary considerably, with reports listing ranges from 200,000 up to 470,000 hectares (Decyk et al., 2022; NV, 2023). The delivery of HMA, together with initiatives for environmental recovery and climate resilience initiatives, can provide multiple community benefits and contribute to climate resilience in the longer term.

Although the links between clearing EO and the environment have not been a priority, their importance and relevance are gaining traction: in this manner, practical environmental initiatives by several mine action organisations are already underway, there is increased donor interest, and updates to the IMAS 07.13 are already in progress. The application of nature-based solutions can be another approach to support climate resilience in communities and across areas that previously included EO-contaminated land.

The term nature-based solutions (NbS) has been adopted by the International Union for Conservation of Nature (IUCN), which broadly defines NbS as actions that can be taken to protect, manage or restore ecosystems,[8] and that simultaneously address societal challenges and provide benefits to people and nature. They target "the major challenges that communities face, such as climate change, disaster risk reduction, food and water security, biodiversity loss and human health, and are critical to sustainable economic development." (IUCN, n.b., para.5) Careful design, collaboration and meeting community needs are critical. Guidance developed through the *NbS in Humanitarian Contexts Working Group* is of particular relevance to the context of HMA programmes (IUCN, 2022), and the Partnership for Environment and Disaster Risk Reduction (PEDRR).[9]

NbS broadly fall into three categories: ecosystem conservation, ecosystem restoration, and land management improvement, with the priority "to leverage the potential NbS to provide multiple benefits, whereby one intervention addresses several challenges." (IUCN, 2020, p.3) While NbS will not be the "silver bullet" to societal challenges, they can support these challenges, depending on how they are implemented. There can be a host of other important NbS that could be applicable for communities and regions, where HMA programmes are taking place. For HMA programmes or any situation, in which NbS are taken into account, it is important that the environmental setting and its sensitivity and the societal challenges to be addressed are well understood.

Societal challenges will vary depending on the regional context. To give an example, increased vegetation could help a mountainous area alleviate the increased risk of more frequent landslides, whereas elsewhere, tree planting can affect water recharge rates and water supply. However, a suite of NbS could be applicable for communities where mine action programmes are taking place, which could include landscape or wetland restoration, or climate-smart agriculture and agroforestry.

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[8] An ecosystem is a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit, see https://ipbes.net/glossary-tag/ecosystem.

[9] PEDRR is a global network of UN agencies, NGOs and specialists working on "promoting and scaling up eco-system-based approaches to reducing disaster and climate risks", see https://pedrr.org/about-us/.

There are parallels between effective NbS and mine action implementation (Alavi et al., 2022). Implementing NbS can also be a stimulus for other socio-economic benefits, such as education and skills development, which will provide the basis for more successful long-term outcomes, as it can help people make more informed decisions because they are more aware of climate change and of how to adapt and develop skills needed for climate adaptation (UNESCO & UNEVOC, 2021). As for mine action programmes, a participatory approach including women, men, boys and girls is needed for the successful implementation of NbS initiatives, ensuring that the needs and structure of local communities are understood and met. Moreover, it is also important for NbS that succession planning is incorporated to ensure that the initiative succeeds and is sustained over time. For example, without aftercare in place, failure rates for planting schemes can be high. For finite HMA programmes, where HMA actors do not stay involved once land is released back to the community, it is necessary to secure community buy-in and support from local people to ensure long-term viability.

HMA actors have an extensive background, community trust, and experience in working with vulnerable groups and supporting building more sustainable livelihoods in the areas in which they work. They have a broad approach to entering into close dialogue with communities when they identify what areas are confirmed hazardous areas when conducting Explosive Risk Ordnance Education (EORE) to reduce the risk of accidents, and impact assessments. Close community dialogue can help identify local priorities and, if needed, the opportunity to communicate environmental risks in addition to the risks from explosives. This community engagement can also help assess the nature and severity of challenges that the community may face from climate change, including the possible effects on livelihoods and income. As a part of community engagement and surveys, mine action typically collects data about intended land use following EO clearance and can help identify the needs and challenges in a community. Increased sharing and coordination with other key stakeholders, such as national environmental authorities and development organisations and conservation organisations, is also key.

Community engagement is critical for mine action programmes, and necessary for understanding climate risks facing local people. (Credit: Norwegian People's Aid)

In BA, Norwegian People's Aid (NPA) is one of several organisations that conduct clearance and increase access to land for agricultural and grazing pastures. In 2021, this included the NPA's start of work along the Inter-Entity Boundary Line between the Republika Srpska and the Federation of Bosnia and Herzegovina. An inter-municipality working group was set up for the mayors of Majevica's five municipalities – Čelić, Lopare, Sapna, Teočak and Ugljevik to help overcome environmental challenges and support the work. As a part of the NPA's assessments, large numbers of previous landslides were recorded across the north-eastern region, where approximately 400 homes were destroyed.[10] Analysis of such data is important to understand both the potential risk from landslides causing landmines and other ERWs to move and remaining ground stability risks. Released land following EO-clearance contributes to economic initiatives, such as tourism

[10] Information provided by Norwegian People's Aid Bosnia and Herzegovina and collected during impact assessment, by NPA' s Selma Antic, TIA/MRE Coordinator.

and environmental initiatives, including a reforestation programme in Majevica, supported by the association "Majevicka Akcija".

Only 7 percent of the land in Tajikistan is usable for agriculture due to the country's mountainous terrain (World Bank Group, 2021). NPA has been working in Tajikistan since 2010 and is now focused along the Tajik and Afghan border, where there are the risks of floods and landslides. The shifting Panj river that makes up the Tajik and Afghan border also creates additional challenges, and the Tajik Mine Action Centre has begun to consider how these challenges can be addressed within the national mine action standards and strategy.

Important lessons can be learnt in countries that receive funding from OSCE participating States and shared best practice. The examples given below demonstrate how mine action can help deliver positive action to address climate change, supported by strong local and indigenous knowledge. The potential extends beyond those areas where direct HMA activities are taking place, and includes enhancing sustainable livelihood opportunities, prevents deforestation and bolsters the protection of natural resources, which are all regarded as key objectives for peacebuilding and defueling conflicts (Ahmadnia et al., 2022). Note that the shown examples cover only the work of international HMA operators, whereas further examples from local and indigenous HMA programmes may exist.

In Lao PDR – the country most severely contaminated by cluster munitions in the world – NPA has been working with local partner Zero Waste Laos (ZWL) to promote staff environmental awareness, reduce the environmental footprint of NPA and support wider community initiatives, such as the Youth Climate Action initiative. In 2022, the initiative had 3,000 fruit trees distributed to, and planted at, 100 schools.

APOPO[11] is the acronym of Anti-Personnel Landmines Detection Product Development, but it denotes also an NGO that undertakes mine clearance work in Cambodia, Angola, and Zimbabwe (APOPO, 2022), and has incor-

[11] APOPO is an acronym for Anti-Personnel Landmines Detection Product Development in English and Anti-Persoonsmijnen Ontmijnende Product Ontwikkeling in Dutch and is a non-profit organisation with Belgian roots.

porated environmental restoration into its 2023-2025 strategy.[12] APOPO promotes syntrophic agroforestry, which is a traditional agricultural technique that combines reforestation with food production. In Tanzania, it has been cooperating with Sustainable Agriculture Tanzania (SAT) to train farmers in sustainable practices, including tree planting, and the use and production of natural fertilizers. APOPO currently has demonstration plots in Tanzania, Ethiopia and Zimbabwe, with plans to expand and establish training and syntrophic farms in Cambodia, Angola and the rest of its programmes and projects.

A pilot project by Apopo was started in 2023, to demonstrate how syntropic farming could support communities impacted by landmines in Zimbabwe. (Credit: Apopo)

In El Salvador, the HALO Trust has been working in a local partnership with Asociación Mangle, on a mangrove restoration project. HALO Trust has been operating in El Salvador since 2017, supporting the government's weapons and ammunitions management programme. El Salvador has seen over sixty percent of its mangrove forests disappear since the 1950s. Mangroves stabilise and protect coastlines, reduce erosion, and provide critical habitats and breeding grounds for fish, shrimps and other marine species.

[12] See https://apopo.org/herotrees/?v=c2f3f489a005.

Mangroves are also important for carbon sequestration,[13] and can be up to four times more effective than terrestrial forests. The project aims to restore 6.8 hectares of mangrove located within the Jiquilisco Bay Reserve, which is designated as an ecologically important wetland under the Ramsar Convention.[14] Similarly, further case study examples in Sri Lanka, Somalia and Ukraine indicate that ecosystem restoration, biodiversity conservation and sustainable land use practices can be integrated into mine action work to provide direct and indirect environmental benefits (Chrystie, 2023).

Restorative mangrove planting in previously mined lagoon and coastal areas, aims to improve biodiversity and provide climate resilience in Sri Lanka. (Credit: The HALO Trust)

[13] The process of capturing and storing carbon dioxide from the atmosphere.

[14] See "The Ramsar Sites Information Service (RSIS)" a platform that provides online information on wetlands that have been designated as internationally important. https://rsis.ramsar.org/ris/1586.

In most conflict-ridden countries, the scale of communities impacted by climate change will likely far outweigh the scope and reach of any mine action programmes, but mine action could be a conduit for hard-to-reach and poorly supported communities. Locally led climate adaptation initiatives also help avoid the risk of maladaptation and ensure that priorities and needs of local communities are reflected and fulfilled better (Rahman et al., 2023). There is ample need for longer-term or area-wide initiatives as well as rapid and disaster-related responses to address impacts from conflict or the displacement of people (Broek & Hodder, 2022), and HMA can assist by opening up opportunities to support sustainable livelihoods once areas have been cleared of explosive ordnance.

Planning for the future

Some HMA actors already implement environmental initiatives. This happens in different regions affected by conflict; yet much more could be done. HMA actors sit in a unique position and can therefore facilitate the much-needed support of local communities.

HMA organisations play a unique role when they work in conflict-ridden areas, given their strong community engagement, close dialogue with national authorities, and often advanced programme and information management systems. In addition to their main objective, i.e. to release safe land, they are familiar with assessing and integrating specific target areas, such as gender mainstreaming. HMA actors should be well positioned in this function to strengthen the link between environmental recovery, climate resilience initiatives and mine action. This includes EORE and community outreach, which can help to improve environmental literacy and empower communities to address the local and global environmental challenges that lie ahead. If sufficient resources and training are provided for the mine action staff, this could serve as an important contribution to conflict-affected regions. By training locals, mine action operators and national authority staff in the value and implementation of climate resilience, environmental initiatives can provide skills that are also relevant when mine action work is complete. In BA, NPA integrates more specific impact assessment indicators and questions on environmental and climate risks and trends, data, and findings that it will be able to share with the local community and other relevant stakeholders, which may serve as the foundation for future environmental protection and initiatives.

Women and girls face higher risks and heavier burdens from the consequences of climate change, since they depend more on natural resources, spend disproportionately more time securing food, water and fuel, and struggle more under climate change pressures (UN Women, 2022). Similarly, in mine action, while women and girls may not account for the majority of mine casualties, they may still be disproportionally disadvantaged (Laws, 2017). Gender and diversity has been a key priority for HMA in conflict-affected areas, with guidelines aiming to integrate gender perspectives in mine action operations and to ensure that everyone benefits equally from mine action activities (UNMAS, 2019). The HMA sector's experience in gender mainstreaming could be applied to climate and the environment in a similar manner.

As climate change and extreme weather threats increase, mine action must assess local climate risks and better understand how climate change could affect their work, whether certain areas – such as those prone to floods, landslides or wildfires – must be prioritised, and how local communities can be better supported. Planning and prioritisation is usually carried out by the national mine action authority, but more support is needed to ensure that adequate climate change adaptation planning is integrated into national strategies and standards, and fully implemented. The OSCE's core donors in the field of mine action can help ensure that these matters are addressed.

The updates that are currently being made to the existing IMAS 07.13 should provide additional guidance on good practices to HMA actors in order to reduce the vulnerability of communities to the effects of climate change once land has been cleared and released. However, IMAS 07.13 is guidance only, and implementation requires a larger environmental awareness to be developed.

With support from OSCE mine action donors and national authorities, there is the opportunity to provide multiple benefits to communities. This should also be embedded into the revision of the Oslo Action Plan for the implementation of the APMBC planned for 2024. The five-year Oslo Action Plan, which was adopted in 2019, does not currently address the environment. National Adaptation Plans (NAPs) under the United Nations Framework Convention on Climate Change are a means for climate adaptation needs and implementation strategies to be set out, yet information on progress in-

dicates that NAPs have not been submitted for most conflict-ridden states to date.[15] The OSCE can provide support by highlighting the gaps and value of integrating mine action into climate adaptation priorities under a country's NAP where this is relevant. The NAP for BA submitted in December 2022, for example, does not refer to EO contamination or mine action (UNFCCC, 2022).

Guidance already exists on how to gather and analyse information on community-level climate vulnerability and capacity, which involves gathering local perspectives and traditional knowledge (CARE, 2019). Combined with country profiles and summaries of climate trends (World Bank Group, n.d.), climate risk information can be used by mine action actors to inform programmes. Knowledge-sharing must be encouraged, which means sharing details on both success stories as well as lessons learnt from implementing environmental projects and the challenges faced in doing so. Sharing outputs from climate risk assessments and information collected on community vulnerabilities with other agencies can enhance knowledge and inform others even after demobilisation and the completion of HMA programmes. The OSCE provides an important platform for supporting collaborations, the exchange of information and best practice, including direct knowledge from OSCE Field Officers.

Data from HMA actors could help disseminate data on environmental degradation, especially given HMA expertise in data management systems, GIS mapping, the evaluation of risk, understanding risk priorities, and communicating these risks to local communities. In all cases, monitoring and evaluation of the HMA activities must properly consider the long-term environmental implications based on planned use once land is deemed safe and released back to the community. Strong local partnerships are important for both delivering environmental initiatives, but also ensuring their success in the long term with successive planning in place. National mine action standards and strategies must also embed these long-term environmental objectives, with the launch of well-planned and designed NbS and climate resilience initiatives to support communities where HMA is active.

[15] The national adaptation plan (NAP) Interactive map of countries with NAPs as of 5 August 2023, https://napcentral.org/submitted-naps.

Ultimately, the potential and planned environmental, socio-economic and cultural impacts of the initiatives must be well understood, and the benefits communicated, helping inform donors and decision-makers, especially where OSCE donors have supported traditional HMA in the past. A centralised database of implemented environmental initiatives and an evaluation of their success would assist in promoting wider adoption and support.

Funding streams are often specific to HMA and disarmament programmes, so encouraging donors to support programmes that have specific environmental objectives may remain a challenge to overcome. Signatories to the Humanitarian Aid Donors' declaration on Climate and Environment are also mine action donors.[16] The declaration recognises the need to increase climate resilience, with an increased focus on the adoption of nature-based solutions, which could be implemented in those communities where HMA is already active.

Importantly, the OSCE ministerial council decision on *"Strengthening the Co-operation to Address the Challenges Caused by Climate Change"* (OSCE, 2021) acknowledges the increasing challenges that climate change poses for both the economy and the environment, aiming *"to facilitate collective and cooperative responses"*. This acknowledgement could provide leverage for better coordination across the OSCE, especially on sharing good practice regarding mine action, increasing capacity for mine action programmes to adapt to the challenges ahead, and supporting the inclusion of the environment as a part of thematic discussions at all forthcoming APMBC and CCM review meetings.

[16] "Humanitarian Aid Donors' Declaration on Climate and Environment" Available at https://humanitarian.forum.europa.eu/system/files/2022-03/Donor%20declaration%20on%20climate%20and%20environment_ENG_0.pdf#:~:text=Climate%20change%20is%20already%20affecting%20the%20frequency%20and,to%20infrastructure%20and%20human%20establishments%2C%20morbidity%20and%20mortality.

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Annex

Biographies

Nataliya Andrusevych is the Chair of the Governing Board of the Resource Analytical Center *Society and Environment*, a Ukrainian think tank working on environmental and climate issues. She has extensive experience in monitoring and evaluating European integration initiatives/processes in the field of environmental protection in Ukraine and regionally. Since 2006 she has led numerous environmental policy researches and (co-)authored a number of publications in the field of European environmental law, international environmental law, monitoring Ukraine's obligations in accordance with the Ukraine-EU Action Plan, Association Agenda, and the Association Agreement between Ukraine and the EU.

Sinéad Barry is an analyst at the climate diplomacy and security programme at *adelphi*, where she works on a range of topics pertinent to the relationship between peace, security, and the climate crisis. Sinéad holds a master's degree in public policy from the Hertie School in Berlin and has held a variety of positions across the peace and security sectors, including research consulting on Syrian post-conflict reintegration, non-profit work in the Kurdish Region of Iraq, and research assistance at the Hertie School's Centre for International Security. Sinéad has also worked as a freelance journalist since 2018.

Dana Bogdan is Environmental Programme Officer in the Secretariat of the Organization for Security and Co-operation in Europe (OSCE). In the OSCE, she has worked in the areas of water management, disaster risk reduction or climate change and security. She currently manages a Global Environmental Facility (GEF)-funded project (one of the largest of this kind implemented by the OSCE) aimed at supporting transboundary co-operation and integrated water resources management in the Dniester River Basin shared between the Republic of Moldova and Ukraine. She holds an MSc. degree in Environmental Technology and International Affairs from the Diplomatic Academy of Vienna and the Technical University of Vienna.

Lieutenant-Colonel **David Burbridge** has served as an engineer officer in the Canadian Army since 2000. From 2016-2020, he was posted to NATO's Supreme Headquarters Allied Powers Europe in Mons, Belgium as the lead staff officer for environmental protection and energy efficiency. He is currently the Deputy Commander of CF Real Property Operations Group within DND's Assistant Deputy Minister (Infrastructure & Environment). He received his MPA from Queen's University (Kingston) and his MSc in Environmental Science from the Royal Military College of Canada.

Linsey Cottrell is the Environmental Policy Officer at the Conflict and Environment Observatory (CEOBS) – a UK charity focusing on the environmental impacts of conflicts. She is a Chartered Environmentalist and worked in the environmental consultancy sector for 25 years, before joining CEOBS in 2019. At CEOBS, Linsey has worked on military greenhouse emissions and supporting the integration of environmental protection in humanitarian disarmament programmes. She is an experienced environmental practitioner, including environmental risk assessment, contaminated land, environmental due diligence, and environmental impact assessment. She is registered in the UK as a Specialist in Land Condition and was also a trustee of the UK's Institution of Environmental Sciences from 2016 until 2022.

Herbert Formayer is a Meteorologist, Researcher and Associate Professor at the Institute of Meteorology and Climatology, University of Natural Resources and Life Sciences, Vienna (BOKU). He has worked in the field of climate analyses and regional climate modelling since 1995. In 1998 he was a visiting scientist at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado, in the research group of Filippo Giorgi. In 2017 he qualified as a university lecturer in the fields of meteorology and climatology.

Gerald Hainzl carries out research about conflicts in Africa, local, regional and international conflict solution mechanisms as well as African security policies and their institutions. He is a member of several research networks and has repeatedly travelled to Africa to conduct study visits and field trips. In addition to his numerous publications on Africa, he also gives presentations and organises seminars in Austria and abroad.

Florian Hasengst is a PhD candidate at the Energy Economics Group of TU Wien after having finished his master's degree in electrical engineering. He works part-time as Researcher at the AUT Austrian Institute of Technology GmbH, Center for Energy. In his research he focuses on the integration of renewable energy technologies into energy systems and he is an expert in open-source energy system modelling.

Gerhard Herda is geologist at the Austrian Institute of Military Geography and develops geoscientific fundamentals for the Austrian Armed Forces. He is part of international scientific projects on the topics of climate change and international security on a strategic level. In addition, he works on the implication of adaptions to current and future effects of climate change on military operations. Gerhard Herda also has a military background as Chemical, Biological, Radiological, Nuclear (CBRN) officer.

Duraid Jalili is a Lecturer in the Defence Studies Department of King's College London. He teaches intermediate, advanced and higher officer courses at the UK Defence Academy as well as online courses for the King's School of Security Studies. Dr Jalili's research focuses on how to catalyse organisational, behavioural and policy change, with a predominant focus on environmental security and educational reform. He also serves as the Senior Academic Advisor for the Development, Concepts and Doctrine Centre (DCDC) of the UK Ministry of Defence, helping to shape the UK MOD's development of military doctrine and concepts.

Helga Kromp-Kolb is an emeritus university professor of meteorology and climatology at the University of Natural Resources and Applied Life Sciences, Vienna, where she also founded and directed the Center for Global Change and Sustainability. As a university teacher and researcher, she is concerned with issues of climate change, sustainable development, transformation of society, education for sustainable development, and the need for paradigm shifts in science and society. She was instrumental in founding the Climate Change Center Austria (CCCA) as well as the Alliance of Sustainable Universities in Austria and is a member of the steering committee of the cross-university project UniNEtZ.

Colonel **Hans Lampalzer** conducts analyses on current developments in the field of peace support and conflict prevention in the Organisation for Security and Co-operation in Europe (OSCE). His applied research and political advice are focused on the politico-military dimension, including *inter alia*, Small Arms and Light Weapons as well as the link between climate and security. Moreover, he supports the Permanent Mission of Austria to the OSCE as a military advisor. He holds a doctorate in intervention research from the Alpen-Adria-University in Klagenfurt.

David Leidinger has been working as climate modeller and data scientist at the Institute of Meteorology and Climatology, University of Natural Resources and Life Sciences, Vienna (BOKU). Leidinger has broad expertise in the fields of climatology, meteorology, and glaciology.

Philipp Maier is a Research Associate at the Institute of Meteorology and Climatology, University of Natural Resources and Life Sciences, Vienna (BOKU). Maier completed his master's degree at TU Wien and has a research interest in the climate and energy nexus.

Beatrice Mosello is senior advisor on climate diplomacy and security at *adelphi*. Her work focuses on researching and advising on climate and conflict-sensitive approaches that deliver on both resilience and peace. Prior to joining *adelphi*, Beatrice worked as sustainability and climate change advisor to businesses in the extractive sector and as a Research Fellow at the Overseas Development Institute in London. Beatrice has a PhD in International Studies from the Geneva Graduate Institute and has been a Visiting Research Fellow at the UN University Centre for Policy Research, the London School of Economics and Political Science, and the American University of Central Asia in Bishkek.

Raquel Munayer is a consultant for climate diplomacy and security at *adelphi*, where she conducts research activities with a focus on climate and environmental impacts to security. Raquel also has a focus on capacity-building, facilitating workshops and trainings on climate change and security, and conducting exercises with practitioners. She also conducts communications activities, including leading the Climate Diplomacy knowledge platform and hosting the Climate Diplomacy Podcast. Raquel has completed undergraduate studies in Political Sciences at the Free University Berlin, and graduate studies on Public Policy and Administration at the University of Potsdam.

Imran Nadeem is a scientist at the Institute of Meteorology and Climatology, University of Natural Resources and Life Sciences, Vienna (BOKU). Nadeem holds a PhD in meteorology from BOKU as well as a master's degree in physics. He has profound expertise in regional climate modelling and in climate data analysis.

Sarah Njeri is a Lecturer in Humanitarianism and Development at SOAS University of London. She holds a PhD from the University of Bradford, Peace Studies department and an MA in Conflict Resolution from the same department. She is an interdisciplinary researcher whose research sits at the intersection between academia and policy and practice especially on mine action and the humanitarian and development sectors more broadly. Her work seeks to and aims at bringing Mine Action back into the academic discourse especially within the studies of Peace and conflict, humanitarian and development studies. She is the incoming Africa Regional Director for the Environmental Peacebuilding Association board of Directors and also a member of the board of Trustees for CEOBS and REVIVE campaign.

Kristin Holme Obrestad is the Senior Climate and Environmental Advisor at Norwegian People's Aid (NPA), responsible for developing NPA's approach to climate, environment and conflict, on a policy and operational level. Holme Obrestad has a master's degree in Political Science from the University of Oslo and has an extensive background in policy, humanitarian and mine action, and climate and environment work.

Nicolas Pardo-Garcia is an energy system expert at the AIT Austrian Institute of Technology GmbH. He graduated as industrial engineer from the Technical University of Valencia, Spain, and holds a PhD in energy modelling systems from the same centre. Pardo-Garcia has previously worked as a scientist at the Institute of Energy and Transport of the Joint Research Centre of the European Commission (EC-JRC), providing scientific and technical support in the energy domain.

Gustav Resch is a Senior Scientist at the AIT Austrian Institute of Technology GmbH, Center for Energy, acting as Thematic Coordinator for Energy Scenarios and System Planning at the Competence Unit Integrated Energy Systems. Resch holds a PhD in energy economics and a master's degree in electrical engineering from TU Wien. Thanks to more than two decades research practice he has broad experience in energy policy assessments and energy modelling – with a focus on renewable energy technologies, energy economics and security of supply aspects.

Florian Raunig is Austria's Permanent Representative to the Organization for Security and Co-operation in Europe (OSCE). He also heads the Department for OSCE and Council of Europe at the Federal Ministry for European and International Affairs and chairs the Economic and Environmental Committee of the OSCE. His fields of expertise are bi- and multilateral diplomacy and development co-operation, having worked for the Austrian Government, OSCE and the European Union.

Felix Schneider is Head of the Department of Military History at the Institute for Strategy and Security Politics at the National Defence Academy in Vienna. He is responsible for issues of contemporary and military history, especially for 17th-21st century issues of Austrian (Military) History. He holds a doctorate and master's degree in History from the University of Graz. Felix Schneider ranks as a specialist on the Second World War and the Cold War as well as security issues concerning climate change in history (Historical Climatology).

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Demet Suna is a Scientist at the AIT Austrian Institute of Technology GmbH, Center for Energy. Suna has a master's degree in electrical engineering and a PhD in energy economics from TU Wien. Her major fields of research are sustainable energy systems, energy economics and energy policies with a focus on energy efficiency and renewable energy technologies.

Gerhard Totschnig is a Research Engineer at the AIT Austrian Institute of Technology, Center for Energy. He holds a master's degree in theoretical physics from TU Wien and obtained a PhD at the Institute of Chemical Engineering, Fuel and Environmental Technology, TU Wien. Totschnig is an experienced energy system modeller with expertise in various fields of the energy sector.

Alina Viehoff is a consultant at climate diplomacy and security programme at *adelphi*. Her work focuses on finding and implementing solutions to the complex challenges related to climate change, peace and security. In doing so, she supports multilateral cooperation and action while promoting local approaches and actors. Previously, she worked as a research associate at the Institute for Peace Research and Security Policy at the University of Hamburg (IFSH), analysing different interpretations of climate security in international relations. Alina holds a master's degree in human geography from the University of Hamburg.

Kira Vinke is head of the Center for Climate and Foreign Policy at the German Council on Foreign Relations (DGAP). She co-chairs the Advisory Board to the German Federal Government on Civilian Crisis Prevention and Peacebuilding and she is a member of the advisory board of Germany's Federal Academy for Security Policy (BAKS). Dr. Vinke is affiliated as a guest scientist with the Potsdam Institute for Climate Impact Research (PIK), where she worked prior to joining DGAP. In 2019 she completed her doctoral dissertation at the Humboldt Universität zu Berlin on the subject of climate change and migration.

Stefanie Wesch is project coordinator of the Green Vision Central Asia project at the Potsdam Institute for Climate Impact Research and doctoral researcher at the University of Hamburg. Her academic background is in conflict resolution and governance. At the Potsdam Institute, Stefanie Wesch has been working on the Climate-Security-Migration-Nexus in the Sahel and Central Asia plus Afghanistan. As of 2023, she was involved in capacity enhancement activities and research-related fieldwork in Niger, Burkina Faso, Kazakhstan, Tajikistan and Uzbekistan.

Peter Widhalm is a scientist at the AIT Austrian Institute of Technology GmbH. He is a data scientist with sound statistical knowledge, high programming skills, and more than a decade of experience in analysing and modelling spatio-temporal data with advanced machine learning and big data methods. Widhalm holds a PhD on computational and applied mathematics from the University of Natural Resources and Life Sciences, Vienna (BOKU) and master's in computer science from TU Wien.

Agnes Zauner is the CEO of the environmental organisation GLOBAL 2000 – Friends of the Earth Austria since 2020. She is an expert in environmental policy, climate justice, just transition as well as political activism and political strategy. From 2016 to 2017 she worked as a political adviser for the Austrian Embassy in Kyiv, Ukraine, supporting the Austrian OSCE Chairmanship and from 2018 to 2019 she worked as a CEO for the Roma organisation Amaro Foro e.V. in Berlin, Germany, before entering her field of passion: environmental protection.

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Why does the issue of climate change and security merit an additional scientific publication? Firstly, the security sector itself contributes to climate change. Moreover, its impact is less understood than that of other sectors. Secondly, security as a global and human good is severely impacted by climate change. Thirdly, global challenges – or even threats – demand global responses. The Organization for Security and Co-operation in Europe (OSCE), the world's largest regional security organization, acknowledged the urgency of the matter in its landmark decision at the Stockholm Ministerial Council in December 2021.

Thirteen articles provide insights into various research findings of experts from different OSCE participating States.

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