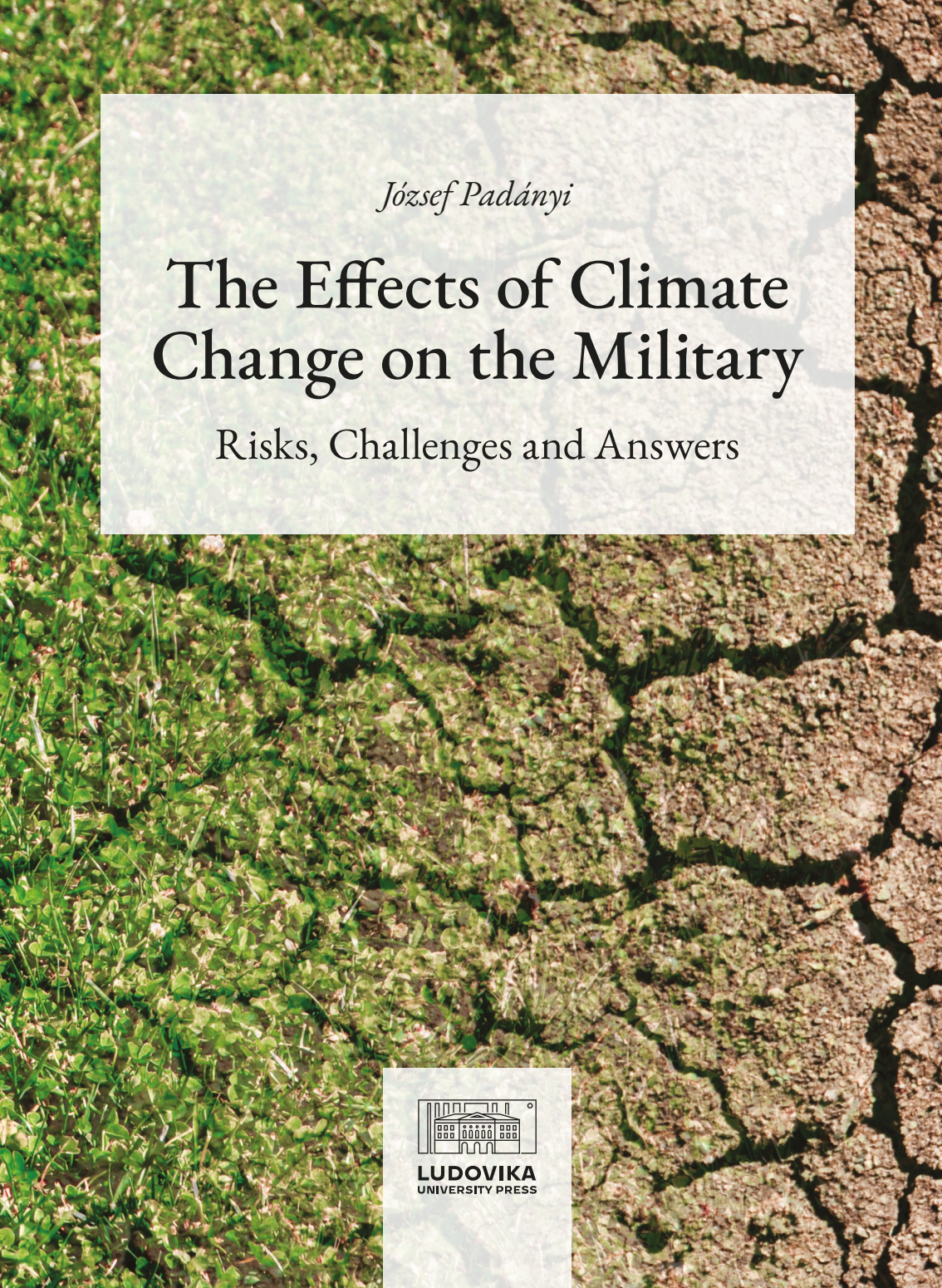

József Padányi

The Effects of Climate Change on the Military

Risks, Challenges and Answers

LUDOVIKA
UNIVERSITY PRESS

József Padányi

The Effects of Climate Change on the Military

József Padányi

The Effects of Climate Change on the Military
Risks, Challenges and Answers

LUDOVIKA
UNIVERSITY PRESS
Budapest, 2024

Consultant
István Gőcze

Published by the University of Public Service
Ludovika University Press
Responsible for publishing: Gergely Deli, Rector

Address: HU-1083 Budapest, Ludovika tér 2.
Contact: kiadvanyok@uni-nke.hu

Managing Editor: Zsolt Kilián
Copy Editor: Zsuzsánna Gergely
Layout Editor: Zsolt Kilián

Printed and bound in Hungary

DOI: https://doi.org/10.36250/01185

ISBN 978-963-653-067-9 (hardback)
ISBN 978-963-653-068-6 (ePDF)

Contents

Introduction

We have been researching the relationship between climate change and military force for more than a decade, with numerous publications exploring the effects of a changing climate.[1] These impacts affect the use of military force, the preparation of forces and equipment, and the direction of military innovation.

In this volume, we highlight the essential theoretical basis and examine the impact of climate change on the security of the nation and the role of military force. We provide an in-depth analysis of natural disaster control and the (increasing) role played by the military in it around the world.

We will assess in detail the impact of weather on military operations, as changes in weather patterns and extreme events can fundamentally disrupt the plans of military leaders. We look at the situation in the United States, the United Kingdom, China, Canada, Australia, Russia, Germany and Hungary, their relationship with climate change and the content of key security documents.

In a separate chapter, we look at the situation of access to drinking water, the growing freshwater conflicts around the world, covering the Crimea, the Middle East, the Nile, India–Pakistan and the Tibetan Plateau.

We also touch on the sensitive issue of how to influence climate change, and on research to reduce emissions by the military force.

At the end of this analysis, a summary of the most relevant documents on the subject is presented in Annex I.

This compilation builds on previous findings, but also draws on the most recent information, analyses and case studies. It draws on a wide range of sources, including the work of national authors such as Tamás Berek, László Földi, Viktor Glied, Anna Páldy, Csilla Péliné Németh and

[1] Including but not limited to Padányi 2010: 32–46; 2012: 111–118; 2021: 31–45.

Réka Magdolna Kirovné Rácz. The foreign language material referred to in this book was translated by the author.

The declared purpose of writing this book is to enable the planners of the ambitious *Defence and Military Development Programme* under way in our country to rely on the information gathered and take the challenges posed by a changing climate into account in their decisions, whether human resources or military technology development, procurement, training or education, as well as preparation.

For our part, at the Doctoral School of Military Engineering at the Faculty of Military Science and Officer Training of the Ludovika – University of Public Service, we pay special attention to the interaction between climate change and the defence sector (including disaster control, water conflicts and the water security of our country).

The English-language book is an extended edition of the Hungarian edition, with a number of new features that present the latest opinions, positions and events.

Budapest, 1 September 2023

József Padányi

Chapter 1

Potential Impacts of Climate Change on the Security of the Nation

For many years, there has been a debate over how the consequences of climate change could affect a country's security and how to respond to the challenges. Many experts are of the opinion that there are a number of factors, the impact of which is not yet known. Of course, these effects can vary significantly due to the increase in adaptability or the nature of the weather extremes that actually occur.[2]

The stress, violence and unrest caused by climate change pose a threat to national security, for which we are not yet prepared, although experts have been predicting it for decades. In the past, it was more likely to be characterised by clashes that erupted out of national pride, religion or ideology. Nowadays, military conflicts have broken out over the lack or scarcity of natural resources such as energy, food or drinking water. Shifts in the cause of threats also affect the vulnerability of countries and the warning signs of national security threats are also changing.

There is debate on the extent to which, and when, scarcity of natural resources and natural challenges will lead to conflicts between states. Some suggest that these causes alone are capable of leading states into war. Others believe that the primary effect will be that conflicts will emerge between countries that have already faced social, economic and political tensions. In any case, it is likely that environmental issues will sooner or later develop into a global conflict.

Peter Gleick, founder and president of the Pacific Institute for Studies in Development, Environment, and Security, outlined three key challenges

[2] Schwartz–Randall 2003.

that he believes are leading to threats to national security. These challenges are as follows:

- Access to fresh water is becoming increasingly difficult, further exacerbated by floods and drought.
- Food shortages due to declining agricultural production.
- Difficulties in accessing strategic raw materials, made more difficult by the presence of ice and frequent storms.[3]

Hungary is no exception to the effects of climate change, where one of the key security documents states: "At the same time, global climate change may also pose challenges and additional tasks for Hungary."[4]

The latest analyses, published in 2022, paint an alarming picture of how our country's temperatures will evolve. Researchers claim that global warming has reduced the average number of frosty days in Hungary from ~120 days per year at the beginning of the 20th century to less than 80 days today. The largest decrease was observed in the North Central Mountains. This trend is projected to strengthen, so that the annual average number of frosty days could decrease by a further five days per decade. The climate change that we are causing is clearly to blame for the changes, because natural influences do not justify this degree of warming. Warming is not only reflected in fewer frosty days.

June 2021 was the driest and third warmest June since 1901. In Budapest, the average number of days with a second-degree heatwave alarms tripled, compared to 100 years ago. Heatwaves and tropical nights, exacerbated by the urban heat island phenomenon, pose a serious health risk, but the built environment and the droughts associated with heatwaves also put agriculture at risk. The upward trend is also observed nationally, with the Little Plain and the Southern Great Plain being the most exposed to the increasing heat.[5]

In terms of energy consumption, warming could even be beneficial, but the increase in temperature is not only true for the winter period. Indeed, winter

[3] Gleick 2020.
[4] Government Resolution 1163/2020 (IV. 21.) on Hungary's National Security Strategy.
[5] Szabó 2022.

warming brings along increased summer heat, so the increase in cooling needs (air conditioning) requires increased energy, which can exceed winter savings. The dual impact of milder winters and reduced extreme cold temperatures on agriculture is another issue, with clear economic consequences and risks through the amount of food produced.

It is also worth referring here to Csilla Péliné Németh's article, in which she referred to alarming changes: increasing storms with extreme wind speeds and, with them, increasing storm damage. She pointed out that, while global warming is causing a decrease in average wind speeds in both hemispheres of the globe, the likelihood of extreme wind events is increasing. Average wind speed trend studies in mountainous areas of the Carpathian region also show a decrease in speed every month. Although this decrease is projected to continue until the end of the century, an increase in storm intensity is also expected.

Based on measurements and model results for central Europe, the number of storms associated with cyclone activity in the Hungarian region will increase as greenhouse gas concentrations rise. Consequently, in the future, stronger wind storms must be expected also in Hungary.[6]

According to the annual reports of the National Directorate General for Disaster Management,[7] Ministry of the Interior (NDGDM), the number of interventions related to storm damage has been on the rise nationwide in recent years. On a stormy day, firefighters are often alerted to technical rescue work on cars, roofs and roads due to fallen trees, downed power lines and broken roof structures. Another problem is the sudden heavy rainfall associated with storms and cyclones, which floods low-lying areas, basements and underpasses. Hailstorms can also cause significant property damage, by damaging roofs and cars, and destroying the crops in orchards and vineyards. In 2021, the first significant hailstorm was caused by a cold front moving through Slovakia on 22 April, which also produced a tornado there. Unfortunately, this phenomenon is no longer unique, as several heavy thunderstorms developed in the Czech Republic, Poland and Germany on 24 June, and a tornado struck

6 Péliné Németh 2021.
7 Péliné Németh 2021.

the Czech–Slovak border towns of Hodonín and Břeclav, causing significant damage and leaving fatalities in its wake. According to an eyewitness:

> "A tornado swept through, which levelled half of the neighbouring village with the land. Only the walls of the houses remained, with no roofs or windows. The windstorm knocked down the church tower and displaced the roof. The school was also left without a roof. The storm uprooted hundred year-old trees. The situation is tragic [...]."[8]

In Germany, eight months in 2020 were too dry and four months too wet. Similarly to 2019, 11 of the 12 months of the year were "too hot", at least compared to the reference period between 1961 and 1990. Although, unlike in 2019, record temperatures above 40°C were not recorded last year, summer temperatures combined with drought have had a negative impact on agriculture in Germany, with implications for Europe as a whole.[9]

In Canada, statistics show that the number of natural disasters requiring the use of military forces has almost doubled in the last decade. One reason for this is that the army is the only force with the right expertise, that is effective and can be mobilised quickly.[10]

The warming rate in the Carpathian Basin is higher than the global average. The number and length of periods of extreme cold are strongly reduced, while a more frequent occurrence of heatwaves is expected. The number of storms associated with more frequent cyclones in winter is expected to decrease, but they may be more intense.

In summer, heat is a major stress on the human body, especially when coupled with low wind speeds and possibly high humidity in the high pressure anticyclone that builds up in summer. In addition, conditions are likely to be favourable in summer for the development of spontaneous thunderstorms, with gale force and even hurricane force wind gusts. In Hungary, the daily

8 Phone interview with Alojz Flachbart, local resident on 26 June 2021 (prepared by the author).

9 MTI 2021a.

10 McSheffrey–McArthur 2021.

wind record was broken on 1 August 2021. The wind gust in Tiszavasvári was equivalent to a gale force wind gust of 121 km/h.

Knowledge-centred development and adaptation are essential to mitigate the damage caused by climate change-related extreme weather events. This in turn requires the development of hazard warning, weather monitoring and measurement systems, and the cooperation of experts and services involved in monitoring, analysing and forecasting dangerous phenomena.

Extreme weather causes serious social and property damage throughout the world. The 2021 report of the Intergovernmental Panel on Climate Change (IPCC) projects bleak prospects. This new report makes it clear that human responsibility for the acceleration of climate change cannot be challenged. Human activity has radically altered the planet's climate and its system. In addition, some processes are caught in a self-expanding loop from where no way out can be seen (such as rising ocean temperatures, retreating Greenland ice sheets and rising sea levels). In at least the last 2,000 years, there has been no warming of such magnitude as what we are witnessing today. A very important outcome of this analysis is that it also assesses complex weather events. These include the coincidence of droughts and extreme heat waves, which do not allow affected communities to recover because natural disasters follow one another in rapid succession. It also takes into account, for the first time, solar radiation management, or geo-engineering, which involves serious risks: such interventions, whether deliberate or accidental, can alter rainfall distributions, and the moderation of warming can vary across the planet, so there may be areas where the situation deteriorates.[11]

The European Union already stated in 2018 that climate change has a direct and indirect impact on international security and stability, affecting in particular the most vulnerable groups, making livelihoods more difficult, increasing environmental pressures and the risk of disasters, which increases the risk of migration and socio-political unrest.[12]

[11] IPCC 2021.

[12] Council of the European Union 2018.

In the light of the above, it is hard to dispute that these are impacts affecting the security of the nation and people's daily livelihoods and comfort. Accordingly, climate change issues are also receiving increasing attention in NATO ('the Alliance').[13] There is a broad consensus among Member States that a comprehensive examination of the relationship between climate change and security and its implications for NATO activities must be part of the dialogue within the Alliance. Accordingly, one of the outcomes of the March 2021 meeting of NATO foreign ministers was to discuss the issue of "climate and security" and prepare a related action plan. Member States agreed that this issue also needed to be addressed at that year's summit (2021). This is all the more the case as the issue will also feature prominently in the new Strategic Concept, in line with Secretary General Jens Stoltenberg's vision for NATO 2030.[14] The Secretary General made the following proposals on climate change:

– NATO should become the leading international organisation in understanding, mitigating and adapting to the impact of climate change.
– In order to achieve this goal, NATO must reflect on how climate change affects NATO facilities and critical infrastructure, and how it impacts operations and other activities. NATO can serve as a key organisation for Allies to identify, monitor and discuss the security implications of climate change.
– NATO must assume a leading role in climate change adaptation. It needs to reduce climate vulnerability and adapt NATO's traditional tasks accordingly, including defence planning and capability development.

[13] We consider the programme of *Green Defence Framework,* created in 2014, a key NATO document. This document focused on three nodes: further increasing the operational efficiency of NATO forces through changes in energy consumption; increasing the sustainability of forces and operations; and meeting environmental expectations by using fewer resources. This also includes *NATO's Smart Energy Programme* (2015), the main outcome of which is the recognition that reducing fuel consumption and replacing it with alternative energy is operationally imperative, as it is not only a cost-effective method and it improves operational agility, but also a security solution (Nyitrai 2018: 104–117).

[14] NATO 2020: 1–67; Stoltenberg 2021: 31–35.

– Emissions from military operations must be examined in order to reduce their volume while improving operational efficiency. The Alliance had to take the lead in reducing emissions from the military sector and contribute to achieving carbon neutrality by 2050.
– A regular high-level global climate and security dialogue starting in 2022 should also be considered, where Member States, partners and other countries could meet and discuss the security implications of climate change.

As we have seen, the challenge of climate change has numerous dimensions. On the one hand, NATO cannot exclude itself from international cooperation and, on the other hand, the changing security environment has an impact on the functioning of the Alliance. At the same time, the defence aspect will remain paramount and cannot be overridden by possible climate change expectations. At the same time, the challenges posed by climate change must be addressed in terms of both planning (analysis and assessment) and implementation (adaptation). The latter is true for both capacity building and for the increasing tasks. Civil–military cooperation, as an important supporting element of the military leader, is appreciated.

The Secretary General pays particular attention to this issue, as he mentioned it again when presenting his report on the Alliance's 2020 activities in Brussels on 16 March. Jens Stoltenberg stressed that strengthening transatlantic unity is the only way to guarantee the security of our allies, and that cooperation between NATO Members to address the challenges facing the Alliance is more important now than ever before. Among the challenges facing the Alliance, the Secretary General highlighted the destabilising behaviour of the Russian leaders, the economic and military rise of China, and terrorist threats and increasingly sophisticated cyberattacks, as well as the security implications of climate change.[15] The fact that the idea is enjoying broad support even before the NATO summit is demonstrated by nothing better than the words of the US Secretary of State, who firmly supported the inclusion

[15] MTI 2021b.

of the effects of climate change on security on the NATO agenda. In his introductory speech, Blinken stressed that climate change could amplify a wide range of emerging threats, most notably mass migration, and that addressing it at NATO level is fully justified.[16]

The Secretary General is keeping his ideas on climate change on the agenda. On 4 June, co-hosted by the Brookings Institute, NATO and the Deutsche Gesellschaft für Auswärtige Politik (DGAP), a video conference with NATO Secretary General Jens Stoltenberg was held, and he outlined the main objectives of the *NATO@2030* package of proposals in nine points. Stoltenberg expects a clear political commitment at the summit on 14 June to reduce military emissions significantly, thus contributing to achieving climate neutrality. The Secretary General identified global competition, sophisticated cyberattacks, terrorism, nuclear weapons and the security implications of climate change as the most significant challenges, which no single country can tackle alone, hence the need for cooperation within NATO.

As expected, the NATO summit declaration also highlights the issue of climate change. It is also named as a security threat by its signatories:

> "The current strategic environment and the Covid pandemic underscore the importance of NATO–EU cooperation to address current and emerging security challenges, in particular resilience issues, new and disruptive technologies, security aspects of climate change, disinformation and strengthening geostrategic competition."[17]

Speaking about the Brussels Summit on 14 June 2021, they underline:

> "Aim for NATO to become the leading international organisation when it comes to understanding and adapting to the impact of climate change on security. We agree to significantly reduce greenhouse gas emissions from military activities and installations without impairing personnel safety, operational effectiveness and our deterrence and defence posture. We invite the Secretary General to formulate a realistic, ambitious

[16] Halmai 2021.
[17] NATO 2021.

and concrete target for the reduction of greenhouse gas emissions by the NATO political and military structures and facilities and assess the feasibility of reaching net zero emissions by 2050. We will also initiate a regular high-level climate and security dialogue to exchange views and coordinate further action.

Climate change is one of the defining challenges of our times. It is a threat multiplier that impacts Allied security, both in the Euro-Atlantic area and in the Alliance's broader neighbourhood. Climate change puts our resilience and civil preparedness to the test, affects our planning and the resilience of our military installations and critical infrastructure, and may create harsher conditions for our operations. Today we have endorsed an Action Plan to implement our NATO Agenda on Climate Change and Security, which increases our awareness, adaptation, mitigation, and outreach efforts, while ensuring a credible deterrence and defence posture and upholding the priorities of the safety of military personnel and operational and cost effectiveness. To increase awareness, NATO will conduct annual assessments of the impact of climate change on its strategic environment as well as on missions and operations. To adapt to climate change, NATO will incorporate climate change considerations into its full spectrum of work, ranging from defence planning and capability development to civil preparedness and exercises. To contribute to the mitigation of climate change, drawing on best practices of Allies, and taking into account their different national circumstances, NATO will develop a mapping methodology to help Allies measure greenhouse gas emissions from military activities and installations, which could contribute to formulating voluntary goals to reduce such emissions. NATO will also strengthen exchanges with partner countries as well as with international and regional organisations that are active on climate change and security issues."[18]

Climate change was also highlighted at the summit in Madrid on 29 June 2022. As stated in a declaration summarising the outcome of the meeting:

"Climate change is a defining challenge of our time with a profound impact on Allied security. It is a threat multiplier. We have decided on a goal to significantly cut greenhouse

[18] NATO 2021.

> gas emissions by the NATO political and military structures and facilities, while maintaining operational, military and cost effectiveness. We will integrate climate change considerations across all of NATO's core tasks."[19]

Today, climate change is mentioned as a security issue in the defence policy documents of more than half of the countries. In the United States, the first such document was published in 2007,[20] and the 2010 Quadrennial Defense Review identified climate change as a national security threat.[21] The 2014 review took a comprehensive approach to the issue, including an analysis of the impact of climate change on military installations, military operations and adaptation. For the latter, the Pentagon has also produced detailed guidance with the following objectives:

- identify and assess the impacts of climate change in the defence sector
- coordinate resources within and outside the defence sector in this area[22]

Defence ministers also agreed at the Paris meeting in 2015 that global warming is "as much a security problem as an environmental one".[23]

It is worth taking a look at the areas where climate change affects the daily life of military force, as this will bring us closer to the necessary and possible adaptations. One possible grouping is as follows:

- the impact of climate change on military installations, manpower and military technology
- reducing defence sector emissions
- increased consideration of climate change impacts in defence strategy formulation
- the possible contribution of military force to human security and disaster response tasks

19 NATO 2022.
20 CNA 2007.
21 US Department of Defense 2010: 84
22 US Department of Defense 2014.
23 Bryant 2015.

– the potential role of military force in preventing climate change-induced conflicts and managing the consequences

There are good national and international practices and research that can be shared to increase the effectiveness of adaptation. Without being exhaustive, we present some initiatives, the recommendations of which we consider worthy of wider consideration.

THE LINK BETWEEN CLIMATE CHANGE AND THE OCCURRENCE OF NATURAL DISASTERS

Responding to an appreciably increasing number of natural disaster relief activities places a heavy burden on military power. It commits resources, increases military output, requires special preparedness, influences training and preparation, and it is integrated into strategic planning.

It is therefore essential to examine the frequency of natural disasters, their causes, their nature and their impact on society. Under natural disasters, in this analysis, cases related to weather, climate and water are studied (floods, windstorms, extreme temperatures, drought). For the overview, we have used the World Meteorological Organization's analysis published in 2021.[24]

The report examines the 1970–2019 period through an analysis of natural disasters related to climate change, weather and extreme weather events (hereinafter: natural disasters). The analysis is suitable for drawing longer-term conclusions, as 11,072 natural disasters occurred for these reasons during this 50-year period, killing 2.06 million people and causing 3.67 billion USD in damage.[25] That's 115 deaths and 202 million USD per day over 50 years. These are incomprehensible figures, but they show that serious changes in nature have begun, mainly due to climate change.

[24] World Meteorological Organization 2021.

[25] In the period under review, a total of 22,326 disasters were reported, with 4,607,671 deaths and 4.92 trillion USD's worth of economic loss.

The report focuses on two aspects: it assesses the situation in terms of deaths and damage caused, with trends always extrapolated to the 10 most devastating disasters, broken down by six geographical areas. This is not intended as a criticism of the report's criteria or the classification of the disasters that have occurred, which we accept without reservation. Where we have comments, they are given in footnotes.

It is not by chance that the 50-year analysis highlights natural disasters related to climate change, weather and extreme flow regimes, as this group accounts for 49.52% of all disasters in the period under review. These events are responsible for 45% of all deaths and 74% of all economic losses.

Natural disasters worldwide

The analysis details the natural disasters that occurred during the period under review. From this we see that, broken down over 10 year periods, the number of natural disasters that have occurred in our environment, and thus its material destruction, is constantly increasing. The exception to this is the last 10 years (2010–2019), when there was a noticeable decrease in the number of disasters. At the same time, the loss measurable in human lives has been steadily decreasing thanks to improving forecasting systems (Table 1).

The high number of natural disasters is a clear indication of the strain on both forces and assets that this type of task places on military forces. They also show that, without the use of military force, it would be impossible to mitigate the consequences of these disasters in any measurable way. The assessment of disasters by type also provides guidance for the preparation of military force.

Looking at the nature of disasters, we see that the most common type in this group is (marine or riverine) flooding with 44%, followed by windstorms (tornadoes, tropical cyclones, etc.) with 35%. Windstorms (39%) and drought (34%) claimed the most lives. The drought period of 1980–1989 was particularly devastating in this respect, as a consequence of which more

Table 1. *Data on natural disasters worldwide, 1970–2019*

	Number of disasters	*Number of deaths*	*Economic loss (billion USD)*
1970 to 1979	711	556,000	175.4
1980 to 1989	1,410	667,000	289.3
1990 to 1999	2,250	329,000	852.3
2000 to 2009	3,536	329,000	942.0
2010 to 2019	3,165	185,000	1,381.0

Source: Prepared by the author on the basis of World Meteorological Organization 2021: 19

than 650,000 people lost their lives. The main causes of economic losses were windstorms (54%) and floods (31%).

Some conclusions can also be drawn by analysing the 10 most devastating natural disasters. They show that the highest number of deaths occurred in Africa (650,000 people), with drought and tropical storms being the main causes. The United States suffered the greatest property damage (526.47 billion USD), the main cause of which was the almost annual devastation caused by hurricanes (Annex II, Tables A1 and A2).

Natural disasters by geographic area

The report also examines the occurrence and characteristics of natural disasters by geographical area. These geographical areas are Africa, Asia, South America and North and Central America, as well as the Caribbean, Southwest Oceania, and finally Europe. A review of the summary data shows that there is no strong correlation between the number of natural disasters, the number of deaths and the property damage caused. The reasons for this are, on the one hand, the different intensity of natural disasters, the level of infrastructure and the effectiveness of early warning systems (Table 2).

Table 2. *Data on natural disasters in the examined areas and global figures*

	Number and proportion of natural disasters (%)	*Number and proportion of deaths (%)*	*Property damage incurred (billion USD) and percentage (%)*
Africa	1,695/15	731,747/35	38.5/1
Asia	3,454/31	975,622/47	1,200.0/33
South America	867/8	57,892/3	100.9/3
North and Central America, Caribbean	1,977/18	74,839/4	1,700.0/45
Southwest Oceania	1,407/13	65,391/3	163.7/5
Europe	1,672/15	159,438/8	476.5/13
Globally	*11,072/100*	*2,064,929/100*	*3,679.6/100*

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021

Natural disasters in Africa

In Africa, 1,695 natural disasters have been recorded in the last 50 years, accounting for 35% of global disaster-caused deaths (731,747 people), but for only 1% of global economic losses (38.5 billion USD).

Looking at disasters by type in Africa, we see that floods are the most common (60%), while drought causes the most deaths (95%). The majority of deaths occurred in Ethiopia (1973 and 1983), Mozambique (1981), and Sudan (1983). In economic terms, the greatest losses were caused by windstorms (37%) and floods (34%), followed by drought (26%).

The distribution of disasters shows a steady increase in the number of disasters occurring between 1970 and 2009, followed by a decrease. In terms of deaths, the period 1980–1989 stands out, accounting for 89% of all deaths. The worst period in terms of economic losses is 2010–2019, when losses of 12.5 billion USD were reported (Table 3). This is almost double the average for the other periods.

Table 3. *Data on natural disasters in Africa, 1970–2019*

	Number of disasters	*Number and proportion disasters*	*Economic loss (billion USD)*
1970 to 1979	85	120,764	6.6
1980 to 1989	174	557,699	5.8
1990 to 1999	265	9,072	7.4
2000 to 2009	627	11,252	6.2
2010 to 2019	544	32,960	12.5

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 25

When analysing the top 10 most destructive natural disasters, it is not surprising that 95% of all deaths (696,334 people) and 38% of property damage (14.37 billion USD) can be linked to this group. Looking at the occurrence of disasters over time, we see that four of these disasters have occurred in the last 10 years.

The greatest loss in human life was in Ethiopia, where 400,000 people died in the droughts of 1973 and 1983, representing 55% of all victims in Africa. In economic terms, South Africa has lost the most in these 50 years, with a total loss of 4.9 billion USD in three disasters (1987, 1990, 2017) (Annex II, Tables A3–A4).

The trend has not changed in the region in 2021 either. In the south of Madagascar, agricultural production is based on the monsoon, but rainfall has been scarce in the last four years. The dry years have dramatically reduced crop yields in the region, putting tens of thousands of people in the most severe level of food insecurity, but hunger threatens millions more, including many children. The UN says this is the first time that famine has been caused exclusively by man-made climate change.[26]

The use of military force to prevent and recover from natural disasters is not an unknown practice in Africa. In 2015, South Africa sent military assistance

[26] Taub 2021.

to mitigate the effects of flooding in Mozambique. Transport helicopters, divers and medical soldiers were involved in the operation.

Natural disasters in Asia

In Asia, 3,454 disasters have been recorded in the last 50 years, resulting in 975,622 deaths and 1.2 trillion USD in property damage. This represents 31% of all disasters worldwide from 1970 to 2019, 47% of all deaths and 31% of property damage. In other words, this area is considered to be at high risk of natural disasters and their consequences. Floods (45%) and tropical storms (36%) pose a serious threat to people living here. The latter are responsible for 72% of all deaths, while the former account for 57% of economic losses.

The temporal distribution of all disasters over the 50 years under study, broken down into 10-year periods, shows a steady increase until the last period, when the figures show a slight decrease. The trend in the number of deaths does not follow the same pattern. The period from 1970 to 1979 was particularly tragic, with four major storms and one flood causing massive losses (401,844 deaths, 41% of the total). The property damage does not show a uniform pattern of change, nor does it follow the pattern of the loss list. Property damage in the last 10 years was particularly high (465 billion USD, 39% of total losses), due to more flooding and tropical storms (Table 4).

Narrowing down the analysis and highlighting the 10 most devastating natural disasters, we find that they are responsible for 70% of all deaths (680,837 people) and 22% of property damage (266.62 billion USD). Tropical cyclones represent a particular threat to this region (Annex II, Tables A5 and A6). Three of these storms top the list of 10, two of which devastated Bangladesh in 1970 and 1990, and were responsible for a total of 438,866 deaths. The third caused 138,366 deaths and struck Myanmar in 2008. In economic terms, China was the worst affected, with six natural disasters causing 60% of the property damage in this group

Table 4. *Data on natural disasters in Asia, 1970–2019*

	Number of disasters	*Number of disasters*	*Economic loss (billion USD)*
1970 to 1979	231	401,844	37.4
1980 to 1989	430	79,643	74.4
1990 to 1999	717	238,643	369.2
2000 to 2009	1,066	199,366	258.0
2010 to 2019	1,010	56,126	465.0

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021

(160.34 billion USD). Floods dominated, but an extreme heatwave in 2008 is also included. It is no coincidence that the Chinese military forces are increasingly involved in disaster response tasks.[27]

The situation is no different in India. Among the tasks of the military forces, participation in disaster response is a high priority. The military is relied upon as a primary intervention force, especially in cases where other intervention capabilities are insufficient or where special equipment and preparedness is required. In 2015, when neighbouring Nepal was hit by a major earthquake, the Indian military forces were the first to respond. The 7.8 magnitude quake killed 7,652 people, injured 16,390 and destroyed nearly 200,000 homes. The Indian army immediately launched relief operations in the area, using the air force's capabilities. In Operation Maitri, people were evacuated by air; medical personnel and military engineers were sent to the site; and water, food, blankets and tents were provided to the people left without shelter. India has also responded immediately to other disasters, helping other countries to normalise the situation:

– In the aftermath of Hurricane Katrina (2005), 25 tonnes of aid (3,000 blankets, 150 tarpaulins, bedding and toiletries) were delivered to the site.

[27] Xinhua 2021.

– After the mud avalanche on the island of Leyte (East Philippines) (17 February 2006), they delivered 30 tonnes of aid (mainly medicine) to the Philippines.
– 86 tonnes of aid were delivered following the earthquake that hit Jakarta (Indonesia) on 27 May 2006.
– During the Lebanon crisis, 3,200 blankets and 225 tents were sent to Lebanon on 18 August 2006.

The Indian Army also plays a prominent role in disasters on home soil. In the aftermath of cyclone Vardah or cyclone Ockhi, all branches of military forces were called in to help. They rescued people, delivered aid, conducted search and rescue operations.[28]

Natural disasters in South America

In South America, 867 disasters have been recorded over the past 50 years, claiming 57,892 lives and causing 100.9 billion USD in economic losses. Floods are the most frequent disaster in this region (59%) and are responsible for 77% of deaths and 58% of economic losses.

When analysing the frequency and distribution of disaster occurrence, a similar trend can be observed as in the African and Asian samples. In other words, there was a steady increase in the number of natural disasters until 2009, followed by a minimal decrease in the last 10 years. This pattern is not followed by a series of deaths, since we see a significant spike in the period 1990–1999 (34,233 dead, 59% of the total casualties) associated with flooding in Bolivia. The distribution of economic losses is also not uniform, with two periods showing outliers (Table 5).

Looking at the 10 most devastating natural disasters separately, they account for 60% of all deaths (34,854 people) and 38% of property damage

[28] Indian Army [s. a.].

Table 5. *Data on natural disasters in South America, 1970–2019*

	Number of disasters	*Number of deaths*	*Economic loss (billion USD)*
1970 to 1979	73	5,158	15.6
1980 to 1989	131	7,159	27.5
1990 to 1999	163	34,233	15.9
2000 to 2009	254	4,996	12.7
2010 to 2019	246	6,356	29.3

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 31

(39.3 billion USD). Floods accounted for 90% of the deaths and 41% of the damage. A notable example is the 1999 floods in Venezuela, which killed 30,000 people and caused a 4.85 billion USD economic loss (Annex II, Tables A7 and A8).

Natural disasters in North and Central America and the Caribbean

In the last 50 years, 1977 natural disasters have been recorded in North and Central America and the Caribbean, responsible for 74,839 deaths and 1.7 billion USD of economic loss. The region accounts for 18% of all natural disasters recorded worldwide, 4% of all deaths and 46% of economic loss. Typically, storms (54%) and floods (31%) were the most frequent. The former caused 71% of all deaths and 78% of all economic losses. The United States suffered 38% of economic losses caused by natural disasters.[29] It is no coincidence that the Department of Defense has assessed all military bases for disaster

[29] In 2019 alone, the United States recorded 14 natural disasters (three floods, eight severe storms, two tropical cyclones and one wildfire), with a total damage exceeding 1 billion USD (World Meteorological Organization 2021: 46).

vulnerability. This is not only for economic reasons, but also for national security reasons, as the loss of a key base from the defence system could put the country at a strategic disadvantage.[30]

The temporal distribution of natural disasters in the study area follows the earlier pattern. It increased gradually until 2009, declining minimally in the last 10 years, but there were still 529 incidents in this period. In all periods, the predominant hazard is windstorms (hurricanes), followed by floods. The distribution of deaths over time does not follow the same pattern, as we see far outliers in the 1990–1999 period (28,398 deaths, 38% of the total). Hurricane Mitch, which killed 14,600 people in Honduras in 1998 and 3,332 in Nicaragua, has a big responsibility in this. The distribution of economic losses shows a steadily increasing pattern decade by decade, with a tenfold increase (727.9 billion USD) compared to the first decade (71.5 billion USD). In the 2010–2019 period, the increase was also caused by windstorms, accounting for two-thirds of the total damage in that decade (Table 6).

The top 10 natural disasters in the region accounted for 54% of all deaths (40,157 people) and 36% of economic losses (597.1 billion USD).[31] It is mainly recurring hurricanes that cause the most trouble, and they also dominate this group, both in terms of deaths (33,492 people, accounting for 83% of total losses) and economic losses (550.85 billion USD, 92% of total losses) (Annex II, Tables A9 and A10).

The continuing vulnerability of the Caribbean led 14 nations to hold a joint exercise in the region in 2021 to develop a cooperative approach to humanitarian assistance, disaster response and recovery.[32]

[30] In 2018, Hurricane Michael destroyed Tyndall Air Force Base, destroying a number of pieces of military equipment, and the base has been closed ever since. In 1992, Hurricane Andrew caused severe damage to Homestead Air Force Base, shutting it down for two years (Wallace 2021).

[31] In the United States, the use of military force in disaster response dates back to the 19th century. In the recent past, the military has been active in almost all flood and windstorm responses. Most notably in the aftermath of Hurricanes Hugo (1989), Andrew (1992), Iniki (1992), Katrina (2005) and the Mississippi floods.

[32] Ministry of Defence 2021.

Table 6. *Data of natural disasters in North and Central America, and the Caribbean, 1970–2019*

	Number of disasters	*Number of deaths*	*Economic loss (billion USD)*
1970 to 1979	109	16,259	71.5
1980 to 1989	267	7,948	96.5
1990 to 1999	482	28,398	267.9
2000 to 2009	590	15,430	492.6
2010 to 2019	529	6,804	727.9

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 43

Natural disasters in Southwest Oceania

In this region, the Philippines is the area most affected by natural disasters, hit by 75% of disasters, leaving 1,000 dead each year.

The region has recorded 1,407 natural disasters, resulting in 65,391 deaths and 163.7 billion USD in economic losses. Most disasters were linked to storms (45%) and floods (39%). The former accounted for 71% of deaths, while storms (46%), floods (24%), droughts (17%) and fires (13%) caused the most economic loss. In Australia, natural disasters caused 88.2 billion USD of economic losses, 54% of the total damage caused by disasters in the region.

The distribution of disasters in the study area shows a steady increase until 2009 and a slight decrease in the last 10 years. The number of deaths has risen constantly and steadily, reaching almost 16,000 in the last 10 years. The distribution of economic losses is uneven over the 10-year periods. The period 2010–2019 stands out, with losses of 56.6 billion USD, representing 35% of total losses (Table 7). This is primarily due to the three tropical storms and two major floods that occurred during this period.

An analysis of the top 10 most destructive natural disasters shows that storms are the biggest threat in the region, accounting for nearly one in

Table 7. *Data on natural disasters in Southwest Oceania, 1970–2019*

	Number of disasters	*Number of deaths*	*Economic loss (billion USD)*
1970 to 1979	151	9,875	20.2
1980 to 1989	229	11,057	26.1
1990 to 1999	253	14,031	36.1
2000 to 2009	402	14,628	21.0
2010 to 2019	372	15,800	56.6

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 43

two (45%). In this group, storms caused 71% of deaths and 46% of economic losses. Group 10 is responsible for 39% of all deaths (25,394 people) and has a significant economic loss (42%, equivalent to 68.6 billion USD). Tropical storms have hit the Philippines hardest; 8 out of the top 10 disasters belong here. In terms of economic loss, seven of the top 10 events are linked to Australia. Cyclone Haiyan, which hit the Philippines in 2013, caused the highest number of deaths (7,354), while the drought that hit Australia in 1981 caused the highest damage (16.85 billion USD) (Annex II, Tables A11 and A12).

Countries in the region have recognised that cross-border natural disasters can only be tackled effectively through international cooperation. A prominent example of this was the joint exercise (Nusa Bhakti AUSINDO 21), in which representatives of the Australian and Indonesian armies practised cooperation in disaster response. In addition to the military, this exercise also involved representatives of civilian aid organisations. The annual command post exercise is to develop the skills needed to ensure rapid and effective cooperation in the event of a disaster.[33]

This group also includes the support Japan has provided to the Philippine army. The aid, worth 500 million yen, is for the purchase of equipment such

[33] Richardson 2021.

as hydraulic tension-cutting devices and other equipment that can be used effectively in disaster response. The two countries are equally exposed to natural disasters, so their cooperation is mutually beneficial. The strategic partnership between the two armies increases their response capability and is not indifferent to their social acceptance.[34]

Japan has a long tradition of involving the military in natural disaster response. Since 1950, the military has been there whenever a major natural disaster strikes the country. This means an average of 200 deployments a year, covering humanitarian operations and disaster response. Ground troops carry out search and rescue operations, deliver aid, participate in flood relief, medical support, water supply and transportation assignments. The Navy performs similar tasks at home and abroad. They have also been involved in dealing with the effects of the 2015 Nepal earthquake, aiding the victims of the 2019 Djibouti floods and the 2020 bushfires in Australia. Their biggest deployment was in 2011, during Japan's biggest disaster, when 180,000 troops and other supporters were involved in the recovery operations after the earthquake and tsunami in Tohoku.[35]

Natural disasters in Europe

In Europe, 1,672 natural disasters have been recorded in the last 50 years. These have caused 159,438 deaths and 476.5 billion USD in damage. Although floods (38%) and storms (32%) were the most common, heatwaves caused the most deaths, accounting for 148,109 deaths (93%) over that period. In terms of economic losses, floods (36%) and storms (44%) caused the greatest losses in Europe.

The extreme heat waves in 2003 and 2010 caused the highest number of deaths, with 127,946 people (80% of the total) killed in these two natural disasters.

Looking at the 50-year data for Europe on a time line, we see that, as in many of the regions presented earlier, there is a measurable, steady increase

[34] Reliefweb 2021b.

[35] Kim 2021.

Table 8. *Data on natural disasters in Europe, 1970–2019*

	Number of disasters	*Number of deaths*	*Economic loss (billion USD)*
1970 to 1979	62	2,275	24.1
1980 to 1989	179	3,365	58.3
1990 to 1999	370	4,313	155.9
2000 to 2009	597	82,919	151.5
2010 to 2019	464	66,566	86.6

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021

in the number of natural disasters until 2009, followed by a decrease in the last 10 years. Compared to the period 1970–1979, the number of such events has increased tenfold in the period 2000–2009.

In terms of the distribution of deaths, the loss of life increased by orders of magnitude in the 20 years from 2000, accounting for 94% of all deaths (149,485).

In terms of economic losses, the period 1990–2009 is the worst, with losses amounting to 307.4 billion USD, or 64% of total losses (Table 8).

The 10 most destructive natural disasters accounted for 81% of all deaths (129,333 people) and 23% of property damage (111.52 billion USD). The former is dominated by heatwaves, the latter by floods and windstorms. In Europe, the most destructive event is the 2010 heatwave in Russia, which killed 55,736 people. On the economic front, the flooding in Germany caused significant damage, amounting to 16.48 billion USD (Annex II, Tables A13 and A14).

Cross-border military cooperation in disaster response is not unprecedented in Europe. The government decree was published announcing the creation of a Multinational Technical Battalion (Battalion) in 2003, to prevent danger and to deal with the consequences of flood waves on the Tisza. Hungary, Romania, Slovakia and Ukraine have agreed to join their forces to combat natural disasters that threaten their citizens and property, and to use their armies to do so. The Battalion is not a permanent organisation; its

elements are designated by the parties and made available upon official request. Each country contributes one technical company (up to 200 people) and the battalion is jointly deployed. The Battalion will hold an annual cooperation exercise in rotating locations.[36]

The Tisza Multinational Technical Battalion recently held its annual exercise in Slovakia. Under the assumed scenario, weeks of heavy rainfall in Slovakia have caused flooding and the battalion has been mobilised to defend the affected areas. The exercise was called *Blonde Avalanche.*

Armies from other European countries are also active participants in disaster response. Without aiming to be exhaustive, a few examples:

– The Belgian Armed Forces was immediately deployed during the flooding that devastated the country (August 2021). To mitigate the effects of the extensive and damaging natural disaster (37 people died and hundreds were injured, more than 15,000 people became homeless, and at least 500 houses were destroyed), technical teams and medical personnel were the first to arrive on the scene. They were involved in rescue, transporting aid, providing first medical aid and later clearing debris and rebuilding.
– In Bulgaria, forest fires caused severe damage in 2021, and the army was called in to help prevent the spread of the fires. Both ground troops and the Air Force participated in the operations and maintained readiness to complete new deployments.
– In Denmark, the military is in the first line of intervention, but only in the event of large-scale disasters that exceed the capabilities of local forces and other interveners. They are involved in preventing floods, forest fires and other disasters, and dealing with their consequences and mitigating the damage.
– In the summer of 2021, Italy was hit by serious forest fires, which were battled by a broad cooperation of local authorities, including the Italian

[36] Government Decree 44/2003 (IV. 3.) on the promulgation of the Agreement between the Government of the Republic of Hungary, the Government of Romania, the Government of the Slovak Republic and the Government of Ukraine on the establishment of a multinational technical battalion, signed in Budapest on 18 January 2002.

Table 9. *Natural disaster causing the largest economic loss in 2021*

Type of disaster	*Location of its occurrence*	*Losses caused (billion USD)*
Windstorm (Hurricane Ida)	United States	65.0
Flood	Europe	43.0
Blizzard	United States	23.0
Flood	China	17.6
Flood	Canada	7.6
Extreme cold weather	Europe	5.6
Storm (Cyclone Yaas)	Asia	3.0
Flood	Australia	2.1
Storm (Typhoon In-fa)	Philippines, Japan, China	2.0
Storm (Cyclone Tauktae)	Sri Lanka, Maldives, India	1.5

Source: Falconer 2021

military forces. Air force assets were primarily involved in fighting the fires, with 300 flight hours and hundreds of thousands of litres of extinguishing agent.

– Montenegro also fought forest fires in 2021. Air force pilots flew 130 hours and delivered tens of tonnes of water to the area to be extinguished.
– Floods devastated the Netherlands in 2021. Soldiers laid down more than 60,000 sandbags, helped clear debris and rubble, and made roads passable. Dutch soldiers have also been involved in fighting forest fires in Albania. Two Dutch helicopters (together with a Czech aircraft) helped the locals to fight the fires effectively in the extreme heat.[37]
– A broad military cooperation was formed in July 2022 to control the forest fires raging in Slovenia. Hungarian, Austrian, Croatian, Italian, Romanian, Serbian and Slovakian soldiers and several military helicopters fought to contain the spread of the fire as quickly as possible.[38]

37 European Organisation of Military Associations and Trade Unions [s. a.].
38 Kozics 2022.

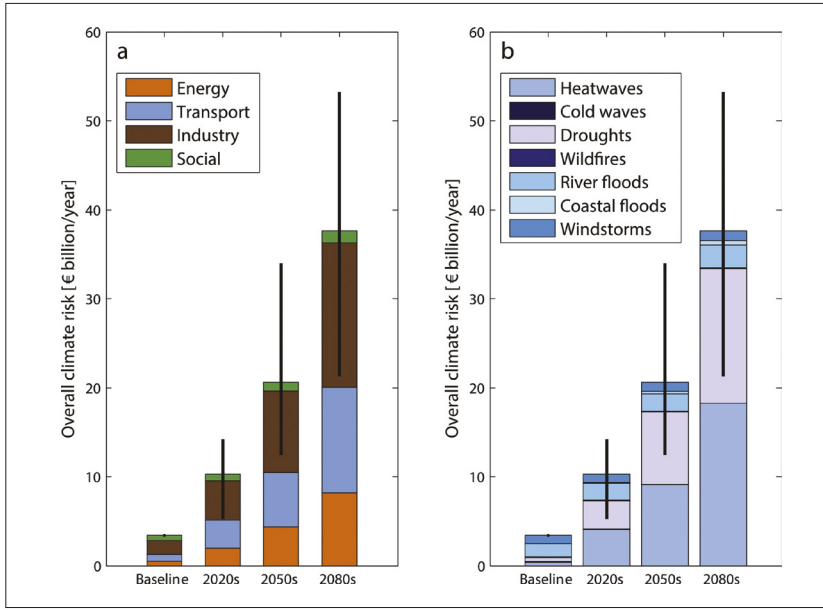

Figure 1. *The cost of climate risks posed to critical infrastructure in Europe*
Source: Forzieria et al. 2018

As for the occurrence of natural disasters, the situation has not changed in 2021, with widespread and severe property damage continuing to occur around the world. Table 9 summarises the top 10 disasters causing the economic losses in 2021.

Unfortunately, the forecasts do not bode well for Europe. They show that the annual cost of damage from the seven most significant climate extremes (heatwaves, cold snaps, droughts, forest fires, river and coastal floods and wind storms) is increasing year by year. The impact of climate change could lead to a six-fold increase in damage by mid-century and a ten-fold increase by the end of the century. Critical infrastructure elements are vulnerable to different degrees and the costs of damage are not the same. Economic losses are likely to be the greatest in the industry, transport and energy sectors. Figure 1 shows that climate change will not only change the extent of damage, but also the proportion of

extreme events that cause it. Figure 1 also shows a) the distribution of damages by sector; b) the distribution of damages between the seven extreme climate risks for four periods. Today, 44% of damage is related to fluvial floods and 27% to windstorms, but in the future the share of droughts and heat waves is expected to rise sharply from the current level of 12% and to account for nearly 90% of damage from extreme events by the end of the century.

DECREASING CARRYING CAPACITY

Today, the carrying capacity, i.e. the ability of an ecosystem to support the number of people in a given area, including social, economic and cultural systems, is being stretched to the limit. In 2021, 29 July was the day of the "global overshoot". On this day, we have used up the planet's year-round renewable resources, i.e. the resources that need to be allocated for the whole year. There is nothing to celebrate in our country either, because in 2021 it was 8 June, while in 2020 it was 14 June. Figure 2 shows exactly how this day changes from year to year, how we use the resources available to us earlier and earlier. In 2020, the pandemic temporarily broke this worsening trend.

The International Energy Agency predicts that global demand for oil will increase by 66% over the next 30 years, but no one knows where this demand could be met from. Clean drinking water is similarly limited in several different parts of the world. With 815 million people worldwide without access to adequate supplies, some experts already believe that we are living well beyond the Earth's carrying capacity. This means that we do not have enough natural resources to continue this way of life and consume at this rate.

Many point to technological improvements and adaptability as a way of managing the global ecosystem. In the past, it really was technological advances that increased the carrying capacity. Over the centuries, we have figured out how to produce more food and energy and access more water. But will the potential of new technology be enough when a crisis like the one I have outlined happens?

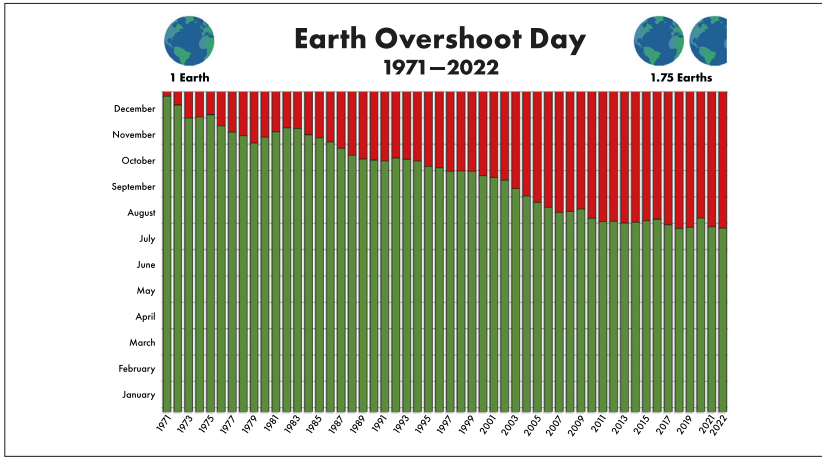

Figure 2. *Rate of use of renewable resources to be used sparingly during the whole year, 1970–2021*
Source: Earth Overshoot Day 2023

If one looks at the carrying capacity at the level of states or regions, it is clear that nations with high carrying capacity, such as the United States or Western Europe, are better able to adapt to sudden weather changes because they have significant resources to mobilise compared to their lower population. This may give rise to the emergence of a stronger "I have, you don't" approach. One could call this selfishness, but the pandemic has shown once again that, in a crisis, the first thing is always to pursue national interests, and then comes helping others.

THE RELATIONSHIP BETWEEN CARRYING CAPACITY AND WAR

Harvard archaeologist Steven Le Blanc looks in detail at the link between carrying capacity and war. Drawing on archaeological evidence, Le Blanc

argues that humans engaged in organised warfare for a variety of reasons, including the struggle for power over resources and the environment. Humans fight when they exceed the carrying capacity of their natural environment. Every time there is a choice between starving or attacking and plundering the other, people choose the latter.[39]

Peace is achieved when the carrying capacity grows, such as through the evolution of agriculture, new and efficient bureaucracies, remote trade links or technological breakthroughs. In parallel, large population declines can lead to periods of peace. A good example is Europe after the great plague epidemics or the situation of the indigenous peoples of North America after European diseases decimated their populations. However, these periods of peace are short-lived, because the population grows rapidly, the carrying capacity declines again, and warfare continues. Over the millennia, societies have defined themselves by their ability to wage war, and the warrior mentality has become ingrained in their thinking. The most militant societies are the ones that are ultimately able to survive.

The situation will change if the explosion of climate change drastically reduces the carrying capacity everywhere. In that case, humanity will revert to previous behaviour and constant warfare for diminishing resources, which warfare itself will further reduce.

The two most likely kinds of responses to the loss of carrying capacity caused by climate change are the defensive and the offensive ones. The US and Australia are likely to fortify their borders, because these countries have the resources and reserves to be self-sufficient. With its diverse growing climate, advanced wealth and modern technology, as well as abundant resources, the United States is likely to survive a shorter climate extreme without any major losses. The country's borders will be closed to keep out starving immigrants from the Caribbean, Mexico and South America. Energy supplies will be stabilised through expensive but essential resources, such as nuclear and renewables, extensive use of hydrogen, and the preservation of energy contracts with the Middle East. At the same time,

[39] Le Blanc – Register 2004.

battles over fishing rights and agricultural subsidies will be a daily occurrence. Tensions between the US and Mexico will increase as soon as the US abrogates the 1944 treaty guaranteeing the Colorado River waters to Mexico.[40] Nevertheless, the US will be in a good position compared to the others. However, it will not be able to shirk its responsibility to reduce the growing military tension around the world. This is true even if it seems that the inward-looking approach and putting national interests above all else are also gaining ground again.

As countries are hit by famine, disease and weather-caused disasters due to sudden climate change, many will find their carrying capacity exceeded. This is likely to trigger aggression to restore the balance. Imagine Eastern European countries, struggling to feed their populations with dwindling food, drinking water and energy, looking to Russia, whose population is already declining, to take its crops, minerals or energy. Or imagine Japan, suffering from flooding in its coastal areas; its drinking water supplies polluted; and poisoning the gas and oil deposits in the Sakhalin Islands, which belong to Russia, as a source of energy for its desalination plants and energy-intensive agricultural processes. Imagine Pakistan, India and China, all three holding nuclear weapons, battling along their borders over refugees, to obtain water from border rivers or for arable land. Spanish and Portuguese fishermen could fight over fishing rights – leading to conflicts at sea. With more than 200 riverbeds that cross several countries, conflicts over access to drinking water, irrigation water and transport routes can be expected. The Danube flows through 12, the Nile through nine and the Amazon through seven countries.[41]

In such a scenario, alliances of convenience can also be envisaged. The United States and Canada could become one, thus simplifying border control.

[40] By 2020, the situation was rapidly deteriorating. The Mexican police have had to intervene several times because the carrying capacity has decreased markedly due to a water scarce agricultural sector, leading to riots. The most serious clash took place on 8 September 2020, when thousands of Chihuahua farmers armed with stones and sticks virtually charged a few hundred police officers protecting a reservoir. In response, the Mexican police are now backed by the military to ensure that no one can pilfer the water of the Conchos and the canal system it feeds (Bede 2020).

[41] Schwartz–Randall 2003.

At the same time, Canada could keep its hydropower for itself, causing difficulties for the US. North and South Korea could ally to form a technically competent and nuclear-armed unit. Europe can act as an alliance, thus putting a check on migration problems and providing protection against aggressors. Russia can join Europe with its abundant mineral resources, oil and gas.

In a world of warring countries, the role of nuclear weapons is becoming more important. The scarcity of existing hydrocarbon resources is becoming apparent, so, with the scarcity of energy sources and the increasing need to access them, nuclear energy is becoming increasingly important, accelerating the spread of nuclear weapons. This also requires countries to develop their enrichment and processing capabilities. China, India, Pakistan, Japan, South Korea, the UK, France, Germany will all have nuclear weapons, and so will Israel, Iran, Egypt and North Korea.

Managing political and military tensions, occasional clashes and the threat of war will be a major challenge. Countries such as Japan, where there is a high degree of social cohesion (i.e. the government can mobilise the population effectively) will be best placed to cope. Countries where diversity is already an issue (India, South Africa and Indonesia) will have problems maintaining order. Adaptability and access to raw materials will be key elements of the crisis. Perhaps the biggest challenge posed by sudden climate change is that we will not know how many years we will have left; ten, a hundred or a thousand years. When the carrying capacity suddenly diminishes, civilisation is faced with a new problem that today we are not able to imagine. Sometimes it seems we don't even want to imagine it.

COUNTER-OPINIONS

There are, of course, other opinions about food safety in the world.[42] Some experts say that, although the world population has doubled since 1961, food

[42] Lomborg 2011.

production has almost tripled. The population of the developing world has slightly more than doubled, while food production has quadrupled there.

This led to a rapid increase in the amount of calories available, especially in the developing world. The proportion of starving people has been falling steadily since 1950, from more than 50% of the world's population to less than 18% today. In the longest-term UN scenarios, their proportion is expected to fall gradually to 2.9% by 2050. By then, 290 million people will still be malnourished.[43]

Four key findings have been made by all major studies that have examined the impact of climate change on agricultural production and global food trade.

First, agricultural production is expected to increase significantly; for example, grain production is projected to more than double over the next century. There is a model that suggests that, globally, land and crop resources, together with technological progress, will be able to support 9 billion people in 2080.

Second, the impact of global warming on agricultural production is likely to be adverse, but not significant overall. The most pessimistic models, which assume the worst climate impacts, estimate a 1.4% overall reduction in agricultural production. The most optimistic model projects a 1.7% net increase in agricultural production as a consequence of global warming. Looking at these figures in perspective, over the last 30 years the average growth in agriculture has been around 1.7%.

Third, while a small change can be expected globally, the situation is different in regional terms. In general, global warming has a negative impact on agriculture in developing countries; however, a positive one in developed countries. This harsh reality is due to the fact that rising temperatures benefit farmers at higher latitudes (as they bring longer growing seasons, with more crops and higher yields), but in parallel it means lower productivity for farmers in tropical countries.

In worst-case scenarios, this will mean a 7% yield reduction in the developing world and a 3% increase in the developed world. We need to address this

[43] Lomborg 2011.

issue, but we need to consider the bigger picture: total production is projected to increase by 270%, even in the least developed countries.[44]

Over the next century, developing countries will become even more dependent on developed countries for food imports. This phenomenon is not primarily due to global warming: even without global warming, imports to LDCs will at least double over the century for demographic reasons. The increase in imports due to global warming could range from 100% to 110–140%.

Consumers in developing countries will live in significantly better material conditions in 2080 than they do today. Consumers in future developing countries will be largely isolated from the processes of agricultural production, will live in cities and their income will come from sectors other than agriculture. As in today's developed countries, the level of consumption will depend mainly on food prices and income, rather than on changes in domestic agricultural production.

Fourth, all factors considered, in the most likely scenario, global warming will be responsible for the malnutrition of up to 28 million additional people. (Other scenarios show a smaller impact, to the point where global warming could lead to an overall reduction in the number of undernourished people by 28 million.)

The extent of hunger is less climate-driven and more economy-driven. Today, there are about 925 million malnourished people in the world. The population is expected to grow by at least 2–3 billion over the next century, yet it is likely that by the end of the century 'only' 108 million people will be starving.[45]

Even if we were able to control global warming to an extraordinary degree (imagine if we could somehow end emissions right now), by the end of the century, we could save up to 28 million people from starvation. By comparison, if we can move from the least economically efficient scenario to one of the most efficient scenarios, we could save 1,065 million people from starving by the end of the century.

Of course, it would be utterly unrealistic to think that we can completely prevent either global warming or the economic drivers of starvation. However,

[44] Lomborg 2011.

[45] Lomborg 2011.

what we should be trying to do is find a scenario whereby, measured in absolute numbers, the least number of people will go hungry, and this is linked to raising their incomes as much as possible.

It is simply not a sensible and ethical strategy to use climate policy to achieve a minimum reduction. Reducing carbon emissions will cause a small, almost insignificant change in the rise in temperature. Had the Kyoto agreement been fully implemented, it would have reduced the number of malnourished people by just 2 million by 2080, at a cost of 180 billion USD a year.

However, if we really care about helping the hungry, we can do a lot more.

This is where cheap and effective responses to malnutrition come in. A panel of Nobel Prize winning experts recommended that the Copenhagen *Consensus 2008* project should invest more in micronutrient supplementation, micronutrient fortification, food improvement and social nutrition programmes, because significant changes can be achieved with minimal investment in these areas.[46]

We can do much more to tackle the often overlooked problem of malnutrition by fortifying staple foods (such as with iron), developing more nutritious crops and supplementing micronutrients more comprehensively. Social nutrition programmes can help create sustainable development that will help families and society as a whole in the long term. We must recognise that the extent of starvation has very little to do with climate.

Further high-profile investments by the Nobel Prize winning panel of experts, such as expanding vaccination and de-worming, improving malaria prevention and treatment, and removing barriers to girls' school enrolment, would make a lasting difference and could make the world's most vulnerable societies stronger and more resilient.[47]

There are also opinions which, while not denying the problem, do not deem a violent solution to be likely. In their opinion:

– the costs of war are extremely great on both the economic and political sides
– international political relations are now much more intensive than letting any country take unilateral violent action

[46] Mach et al. 2019: 193–197.
[47] Mach et al. 2019: 193–197.

– in spite of appearances, the interests of the parties are not entirely mutually exclusive in the use of freshwater resources that feed several countries, and many solutions can be worked out that benefit everyone quite well

This position is based on the assumption that ongoing dialogue, mutual acceptance of expert opinions and constant consultation with all stakeholders can stop the tendency to seek a violent solution.[48]

An analysis published in the journal *Nature* shows that the authors agree that climate change is not the biggest cause of armed conflicts. Rather, they are caused by low socio-economic development, a weak state, ethnic differences between groups and the recent impact of violent conflict.

In their view, relations between climate change and natural resources do not necessarily mean that scarcity of climate-related resources increases the risk of conflict. Scarcity may encourage cooperation to ensure equitable distribution of resources, or reduce the risk of conflict by increasing the time spent on food procurement or because conditions are not conducive to maintaining armed forces.

However, experts agree that future effects of climate change will increase the risk of armed conflicts. Some experts estimate that the risk of conflict due to climate change will increase from a 0–15% probability to a 10–50% probability if global warming exceeds 4°C.[49]

There are also those in the US Senate who view the military leaders' reaction to the national security risks posed by climate change as excessive. Senator Mike Lee says climate change is a fact, but it is not the job of the military to deal with it. Increasing economic efficiency, innovation and technology will solve the problems of climate change, so the focus should be on that.[50]

As the number of natural disasters caused by climate change increases, the participation of military forces in these tasks will also increase. This fact is not denied by anyone, but here, too, we meet with opinions that cautiously

[48] Fülöp 2020.
[49] Mach et al. 2019: 193–197.
[50] Dickson 2021.

approach military participation in humanitarian operations. Some NGO experts see the image of NGOs to be at risk because of joint operations. They are afraid that their neutrality and independence will be called into question, and even see security risks associated with the involvement of military force in some situations.[51] The UN is also of the opinion that military force is a last resort in humanitarian crises.

Experts living in a country where military force has played a questionable role in the past have a unique perspective. There are many countries in Latin America where the dark memory of military dictatorship and the use of military force domestically is still vivid. Some experts here would prefer to see an increased role for civilian response forces, preventing "the reopening of opportunities for generals in disaster response that are undesirable".[52]

It is not our task to do justice between different opinions. However, all approaches agree that action is needed. For our part, we prefer an approach which, although perhaps more sceptical than it actually is, anticipates that security and, one of its key players, military power, will be affected by climate change.

We consider it our task to think ahead, to try to anticipate the problems and the answers to them that will maintain the security of our country. The directions of military force development should be planned 15–20 years ahead. This is the time needed to develop new capabilities in human resources, technical equipment and operational systems.

THE IMPACT OF WEATHER ON MILITARY OPERATIONS, OR WEATHER IS A SOLDIER'S BEST FRIEND

Weather is as much a determining factor in the environment of military operations as the terrain or the time available. In military history, there are many examples where changes in the weather have brought success to one side

[51] Hofmann–Hudson 2009: 29–31.
[52] Scuticchio 2015.

and failure and destruction to the other. Below is a brief summary of these, based on a paper by László Szűcs.[53]

The term *kamikaze* became common after World War II. However, the origins of the term go back much earlier: to the 13th century, to be precise. The first major setbacks of the Mongol Empire, which conquered much of the known world at the time, were the failed invasions of Japan in 1274 and 1281. In 1274, a Mongol fleet of 300 large and nearly 500 small ships headed off from China, carrying more than 20,000 warriors and their horses, and landed on the island of Kyushu on 19 November. Although the attackers were stopped by the Japanese, their retreat was due not to the fighters but to the huge storm that broke out during the night. The Mongol fleet again set sail for Japan in the summer of 1281. The attackers were stopped and driven back to their ships in the battle known as the Second Battle of Hakata. The fleet was then hit by a powerful typhoon, the 'divine wind' or kamikaze. Most ships of the attacking fleet were completely destroyed.

The Battle of Agincourt, one of the bloodiest battles in the history of the world, was fought between the English and the French on 25 October 1415, in the Hundred Years' War. The English longbow played a key role in the battle, which ended in an English victory, and they were even helped by the weather. Rain before the battle for several days had turned the ground into a sea of mud, on which the French, wearing heavy armour, could advance only slowly. Taking advantage of this opportunity, the English, with their arrows, staged a genuine bloodbath, almost wiping out the French nobility. Some 7,000 French counts, barons and marquises were left dead on the battlefield. The English, on the other hand, lost barely more than 200 men.

Those fighting in the American War of Independence were not spared by the weather either. In the winter of 1777–1778, General George Washington was forced to retreat after the British captured the city of Philadelphia. He decided to spend the winter on the well-defensible Valley Forge plateau at the Schuylkill River. But the weather was unkind to them, with heavy snowfall

[53] Szűcs 2014.

and temperatures plunging well below freezing. Subsequently, there were alternating periods of frost and mild temperatures, making the roads almost impassable. The scarcity of food and the harsh weather caused many people to fall ill and die. However, the 'strategic advantage' was not exploited by British General William Howe, who spent the winter in Philadelphia with his army of over 15,000 men and did not attack Washington's weakened army. Supplies came in March with the good weather: the French entered the war on the American side, and the battered army was saved.

The weather was truly strange a few months before the French Revolution of 1789. Life in crisis-hit France was made even harder by an unprecedented spring drought, which pushed up food prices. In early summer, a huge hailstorm destroyed any remaining crops, creating a desperate situation for the population. By this time, a war-like sentiment prevailed among the French, who were also demanding political change. Shortly afterwards, on 14 July to be precise, the revolution broke out.

The fate of the French people was influenced by the weather, not only before the Revolution of 1789, but also at other times. During Napoleon's campaign in Russia in 1812, some 450–680,000 soldiers marched on Moscow. However, the weather had already started to weaken the imperial troops by the summer. The initial heatwave was replaced by heavy summer showers and thunderstorms, which for a day or two resulted in mud on the already poor Russian roads and then deep ruts that dried hard, slowing not only the advance but also the flow of supplies. And the Russian winter, which arrived soon afterwards, finally halted the French advance. Freezing temperatures of –20–30°C decimated Napoleon's army. It is recorded that the soldiers navigated their retreat westwards in the November winter by following the line of frozen bodies lying on the road.

According to historians, the Crimean War was prolonged by nearly two years by a huge storm that struck the Bay of Balaklava near the Crimean peninsula on the night of 14 November 1854. In a matter of hours, it destroyed the combined Anglo–French flotilla anchored there and fighting alongside the Turks against the Russian army. The Crimean War of

1853–1856 was sparked by a dispute between Catholic and Orthodox church leaders over the holy sites in Jerusalem, which were then under the jurisdiction of the Ottoman Empire. The conflict finally ended with the defeat of the Russians.

The cold, wintry weather also helped the Japanese win the Battle of Mukden, the last major land battle of the Russo–Japanese War and one of the biggest confrontations before the First World War. The turning point in the battle, which took place between 20 February and 10 March 1905, was the freezing of the Hun River, which allowed the Japanese to cross it with the aim of encircling the Russian forces. The Russians, however, decided to retreat, and the Japanese marched into Mukden. In the battle, the Japanese suffered 75,000 casualties, while the Russian dead and wounded totalled 90,000.

In World War II, the Germans, learning from Napoleon's failure, planned to carry out Operation Barbarossa against the Soviet Union over the five months between 15 May and mid-October 1941. But the weather thwarted their plans too. The late spring thaw meant that the start of the campaign was changed to 22 June, and the prolonged fighting was further complicated by atrocious weather, which meteorologists called the 'winter of the century'. The soldiers' clothing did not provide adequate protection against the nighttime temperatures of –20–30°C. The result is known: the German offensive was stopped just outside Moscow. The 'white hell' continued to sour soldiers' life fighting on the Eastern Front for years to come. Just think of the siege of Stalingrad or the breakthrough on the Don.

The weather also played a major role in the Japanese success at Pearl Harbor. Admiral Yamamoto Isoroku's fleet of six aircraft carriers, battleships, cruisers and submarines made the 12-day, over 7,000 km journey from 26 November to 7 December 1941 under the cover of heavy winter storms. The skies only cleared when they anchored 400 kilometres from Pearl Harbor.

If you have to mention just one operation that was postponed because of the weather, most people probably think of D-Day, the Normandy landings. The invasion of France was originally scheduled for 5 June 1944, but a storm in the English Channel caused the Allied commander-in-chief, General

Dwight D. Eisenhower, to postpone the attack for 24 hours. Even so, the landing was made very difficult by the adverse weather, which was unusual for June.

Many of you will probably remember the superbly cast film, *Battle of the Bulge,* which told the story of the German counter-attack in the Ardennes in December 1944. The Germans deliberately timed the offensive so that the foggy and overcast weather would prevent the Allies from using their air force, which by then had gained total air superiority. The German troops were initially successful, but on 23 December the weather changed; the fog lifted and the Allied air force, which immediately took off, halted the German attack.

In 1951, an incoming cold front in the Korean theatre of operations resulted in 75% of personnel being incapacitated at battalion level due to minor and major frostbite injuries.[54]

Climate change and the Arab Spring

In February 2013, The Center for Climate and Security and the Center for American Progress published the book of *The Arab Spring and Climate Change. The Weather and Security Nexus.* That book includes a series of papers discussing how climate change has contributed to the evolution of events.[55]

In one of the studies, the authors highlight how a prolonged drought in Syria, exacerbated by the Assad regime's governance and misuse of resources, forced nearly 800,000 people to migrate. Their plantations had been destroyed and their livelihoods made impossible. The migration has increased the pressure on already overburdened Syrian cities, further worsening the quality of the infrastructure, making access to drinking water more difficult and reducing access to jobs. The combined effect of social, economic and environmental pressures, exacerbated by the consequences of climate change, has made the pre-existing 'social contract' between citizens and the government

[54] Fehérvári 2001.
[55] Werz–Hoffman 2013.

impossible to achieve, and strengthened the opposition movement and irreparably damaged the legitimacy of the Assad regime.

The study points to the need to restore political and economic order in Syria. At the same time, no matter how stable the situation in the country is, it will be necessary to respond to the basic problems of livelihoods, which have been accelerated by climate change. The availability of basic resources, such as food, drinking water and arable land, is equally as important as the existence of a stable and accepted government.

> "If climate change mitigation and adaptation are not part of government plans, and if the international community does not support this effort, the acceptability of the respective governments in the Arab world is unlikely to improve and the stability and prosperity of the region will decline,"

Conclude the authors of the study.[56]

The impact of El Niño

Between 1982 and 1983, El Niño caused massive devastation in several Central American countries, significant property damage to the United States and even affected the weather in Europe. Since 1985, thousands of experts around the world have been trying to observe, understand and predict this extraordinary climatic phenomenon. Observation equipment had been deployed in many places around the world, but these failed to predict the severity of the 1997–1998 El Niño onslaught. At the time, no-one thought it would be the natural disaster of the century: droughts and fires in the western ocean (Indonesia and Australia), floods, agricultural and infrastructure damage in Africa and the Americas. All this has claimed the lives of some 22,000 people and caused damage worth 34 billion EUR.

[56] Werz–Hoffman 2013.

Scientists have already explained the collapse of several previous civilisations to such climatic fluctuations, such as the Maya in Central America, the fall of the Angkor civilisation in Cambodia, and the collapse of kingdoms in Thailand and Vietnam due to prolonged dry periods. Similar climate crises have been documented in ancient Egypt and China. The eruption of the Laki volcano in Iceland in 1784, which covered Europe with a huge ash cloud, may have been one of the triggers of the French Revolution of 1789.

Some researchers see evidence that there were twice as many civil wars in the El Niño years between 1950 and 2004 as in other years. A group led by Solomon Xiang of Columbia University in New York published a study in *Nature* on this topic. In this study, the researchers examined 234 civil wars over a 54-year period, in which more than 25,000 people died (more than 1,000 people were killed in half of the conflicts). The researchers divided the world into two halves: one half of the world felt the effects of El Niño.[57]

They found that the number of wars in the affected countries doubled in the years during El Niño, meaning that El Niño is responsible for one in five civil wars. In 1982, a particularly severe El Niño effect hit South America, the corn crop dried up, and that year saw the beginning of the Shining Path resistance movement in Peru.

In Sudan, armed conflict broke out between the north and south of the country during the El Niño years, i.e. in 1963, 1976 and 1983, resulting in more than 2 million deaths. It was the most deadly conflict since the end of World War II.

The direct and indirect health impacts of El Niño are difficult to quantify. However, experts agree that the impact can be detected in all factors affecting human health:

– Extreme rainfall and subsequent flooding will result in significant human losses, mass infections, the collapse of health systems and an increase in mental illnesses.

[57] Hsiang et al. 2011: 438–441.

Table 10. *The impact of El Niño in Peru, in the years indicated*

	1982 and 1983	*1997 and 1998*	*2017*
Number of victims			
Deaths	512	366	138
Injured	1,304	1,040	459
All affected	1,270,000	531,104	1,740,000
Infrastructure destruction			
Highway (m)	2,600	3,136	13,311
Bridge (each)	47	370	449
Houses demolished (each)	98,000	42,342	63,802
Houses damaged (each)	111,000	108,000	350,181
Schools damaged (each)	875	956	2,870
Healthcare institutions damaged (each)	260	580	934
Total losses (billion USD)	3.28	3.5	3.1

Source: French et al. 2020

– Extreme droughts and widespread bush and forest fires lead to famine, infectious diseases, reduced capacity of health care systems and mass respiratory diseases.[58]

Even so, other researchers say there is no evidence that climate change is responsible for the conflicts; they believe it is speculation. However, renowned historian Jared Diamond believes the link between dry periods and wars is obvious: people who are desperate and malnourished feel they have nothing to lose and start civil wars.[59]

El Niño caused major destruction (mainly flooding) on three occasions in Peru alone. The consequences of these events are summarised in Table 10.

[58] World Meteorological Organization 2021: 71.

[59] Else 2019.

Climate change, migration and conflict

The 21st century will be defined by the impacts of climate change, and the responses to and costs of these impacts. Even if nations around the world immediately reduce their emissions of harmful gases, which is very unlikely, the rise in temperature cannot be avoided.

As these effects continue, they will have serious consequences for the national security interests of states, including global security.

Climate change poses a clearly identifiable threat to the national security of the United States, for example. Intelligence reports have concluded that, in the coming decades, vulnerable regions (such as sub-Saharan Africa, the Middle East, South and Southeast Asia) will face food and water shortages and catastrophic floods caused by climate change. Addressing these situations may require US, European or international military action.

The difficult economic and social situation and the lack of opportunities in the Middle East and North Africa create conditions for many young Arabs that, at the slightest spark, will result in an explosion across the region. The degradation of the environment and the migration of people from rural areas to overcrowded cities, coupled with rising food prices, burdened by flawed economic and political decisions, have been that certain spark that has caused the unleashing of unrest.

It does not take much foresight to recognise that the effects of climate change will create even greater pressures in the decades ahead. In particular, mass population movements and the political crises they cause will create new, more complex threats. The order in which and how the governments concerned intend to respond to these new threats is therefore crucial.

Climate change itself is a frighteningly big challenge. No matter what the global economy does to reduce emissions, warming is inevitable. The effects are already being felt today and will only get worse. A good example is Africa, which is the most vulnerable in this respect. 250 million people are at risk due to insecure access to food and drinking water. Low-lying areas are threatened by sea level rises. Only 1% of Africa is low-lying along the seashore, but this area accommodates 12% of the urban population.

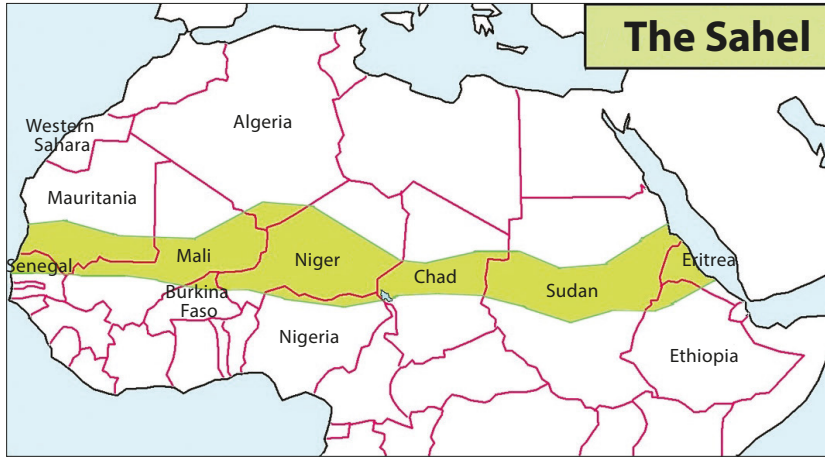

Figure 3. *The Sahel, south of the Sahara*
Source: MTI 2018

The fact that most people in Africa live in low-lying areas, such as the Sahel, is also a risk factor (Figure 3). It is here that the consequences of water scarcity, rising temperatures and longer dry seasons are likely to be most severe. Here, 29 million people (5 million more than last year) were in need of humanitarian assistance in 2021.[60] This situation is made more difficult by a lack of regional and national capacity to help reduce or eliminate the impacts of climate change. The same circumstances also characterise the situation of many Asian and American states and have serious implications for developed countries, such as the United States and states in Europe.

Mass migration opens up a new chapter in this scenario. In the 21st century, the world faces a huge number of climate refugees. People whose lives were frustrated by climate change, happening slowly or even suddenly. The UN estimates that there are already 700 million internally displaced people. People who have left their homes but try to make a living in their own countries.

[60] UNICEF 2021.

Oli Brown, an expert at the International Institute for Sustainable Development (IISD), believes that by 2050 the number of refugees could increase tenfold.[61] There is considerable debate among experts as to whether climate change or other factors cause migration. While the causes of migration are not easily identifiable, the political changes it causes are very much real. A 2010 report by the International Organization for Migration, in conjunction with various UN agencies, projects figures such as "from 200 million to 1 billion" refugees by 2050, due to climate change alone. As the report puts it:

> "The environmental drivers of displacement are often complemented by economic, social and development drivers that can accelerate or, to some extent, cover up environmental impacts. There are several different environmental causes of migration, including gradual environmental degradation (desertification, soil and coastal erosion) and also natural disasters (earthquakes, floods and tropical storms). What is clear is that climate change will exacerbate existing conditions that are already causing displacement."[62]

This last layer is the most unpredictable, both on national and international levels. This is forcing the international community to confront the challenges of climate change and displacement amidst an increasingly fragmented local and regional security environment, in the face of the major conflicts of the 20th century and the subsequent Cold War period. National security in most countries increasingly has to reckon with non-state actors and non-traditional challenges, such as the fight against al-Qaeda and its affiliates.

As these three components (i.e. climate change, climate refugees and conflict) add up, the consequences will become more severe. For example, it is impossible to predict the outcome of the Arab Spring process, but the emergence of democracy and the need for it in some countries is an unintended consequence of climate change and high food prices. At the same time, the combination of these factors can create complex crises where domestic politics, international politics, humanitarian aid and security are interlinked in new ways.

[61] Brown–Dimsdale 2021.

[62] International Organization for Migration 2010.

What can key actors do to work together to create a sustainable security process that helps resolve the challenges of climate change, migration and conflict? One option is that the following actions could jointly make progress in this area:

- Implement institutional reform within government that identifies and names the link between development and security, prioritises preparing for the long-term humanitarian impacts of climate change and mass migration, while treating it as a national security issue.
- Strengthen cooperation between governments in different regions of the world.
- Increase budgetary support for the Global Climate Change Initiative.
- Ensure a better flow of information and a more effective response to disasters, and improve the functioning of early-warning systems.
- Support and encourage scientific research to increase our knowledge on the issues of desertification, rainfall variability, disaster occurrence and coastal erosion, and their impact on displacement and conflict.
- Identify the regions that are most vulnerable to climate-induced migration, thus laying the foundations for more effective aid preparation, programming and distribution.
- Recognise that migration is a proactive adaptation strategy of local populations.

Therefore, a truly sustainable approach to security requires that we do not only consider traditional security issues, based on interstate interactions. It must also be understood that national security will also be enhanced by improving the living conditions of individuals in the developing world and by embracing the need for collective responses to the shared problems caused by climate change.

Climate change, migration and conflict in South Asia[63]

In the already conflict-ridden regions of South Asia, climate change and a worsening migration situation could create new security concerns. South Asia

[63] Bhattacharyya–Werz 2012.

Figure 4. *India's endangered regions*
Source: Bhattacharyya–Werz 2012

will be among the regions most severely affected by climate change. Higher temperatures, more extreme weather, rising sea levels, increasing cyclone activity in the Bay of Bengal and Persian Gulf. Floods are a threat due to the region's complicated water systems, all in areas of high population density. India and Bangladesh in particular will feel the severity of these challenges.

The consequences of weather change will alter and in many cases worsen living conditions in many areas. Extreme weather events and worsening living conditions

will most likely force people to leave the place they live currently, temporarily or permanently, and move to another village, city, region or even country.

The Asian Disaster Preparedness Centre recently reported that Bangladesh "[is] already under great pressure from increased demand for food and excessive utilisation of land and water resources".

Recent disasters in South Asia outline the future. The September 2012 floods in Northeast Assam displaced 1.5 million people, while Cyclone Aila forced 2.3 million people in India and 850,000 in Bangladesh to flee their homes.

The situation is getting worse, as evidenced by a 2019 heatwave, reaching nearly 50°C. In India, this was the daily reality for tens of millions of people in May and June. Extreme drought and water shortages have hit large parts of the country every year since 2015 (apart from 2017). True, there has never been a heatwave like the one in 2019, and it was the worst drought in 60 years. According to a 2018 government forecast, 21 major cities in India, including Delhi, Chennai, Bangalore and Hyderabad, will soon run out of groundwater, and by 2030, 40% of Indians will be without access to drinking water. In mid-June, tens of thousands of people took to the roads in the country's poorest northern states, with villages deserted in Bihar, Rajasthan and Uttar Pradesh, as long as the heat lasted[64] (Figure 4).

Climate change, migration and conflict in Northwest Africa[65]

Northwest Africa is increasingly affected by weather, migration and security challenges. Workforce migration has long been a major concern in this region, bringing masses of migrants from sub-Saharan Africa to the Mediterranean coastal area and Europe. To complete this overland journey, migrants often pass through the Sahel and Sahel-Saharan regions, which face increasing risks due climate change. Rising sea levels, desertification, droughts and climate

[64] Qubit 2019.

[65] Werz–Conley 2012.

Figure 5. *Migration routes in Africa*
Source: Baobab News 2023

change jointly increase the number of migrants and make these routes increasingly dangerous. These challenges are compounded by the region's ever-present security threats, such as Nigeria's struggle with internal insurgency and the growing strength of al-Qaeda in the Islamic Maghreb.

For the international community, this region is a key area, due to its instability. The proximity of Algeria and Morocco to Europe, the rise of Nigeria, one of Africa's strategically most important countries, and Niger's ongoing

struggle for governance and against poverty all demand attention. Northwest Africa's uncontrolled borders and limited resources, which allow al-Qaeda to gain strength, suggest that there is no time to lose to develop a better and more effective policy in the region.

Nigeria, Niger, Algeria and Morocco comprise the tension zone in Northwest Africa. These four countries, separated by the Sahara deserts, are rarely considered to be a contiguous region. Still, they are connected by existing international migration routes that ripple from sub-Saharan Africa to the Mediterranean coast and transport people and goods to Morocco, Algeria, Libya and then to Europe. Seasonal manpower flows are high in the region, especially in areas vulnerable to rainfall fluctuations (Figure 5).

Why should the international community worry about the link between weather, migration and security in Northwest Africa?

For a relatively small investment, we could make significant progress in increasing security and preparing the region. The costs of securing livelihoods, extending irrigation, monitoring migration and improving regional cooperation over water consumption are dwarfed by the costs of future humanitarian disasters, long-term security issues and conflicts.

The situation has not really improved in recent months either. The quarterly migration report published in July 2021, covering East Africa and Yemen, states:

- 2 million people in Ethiopia were internally displaced and 63,000 have fled to East Sudan
- Yemen received 1,331 refugees during April–May 2021; it is a 54% decrease compared to the same period last year
- 150 refugees lost their lives when their boat crashed off the coast of Yemen
- in two weeks, more than 30,000 refugees have been returned from Saudi Arabia to Ethiopia[66]

The figures cited show that migration has not slowed down but is continuing in the region. The situation is not made any easier for the authorities by

[66] Reliefweb 2021a.

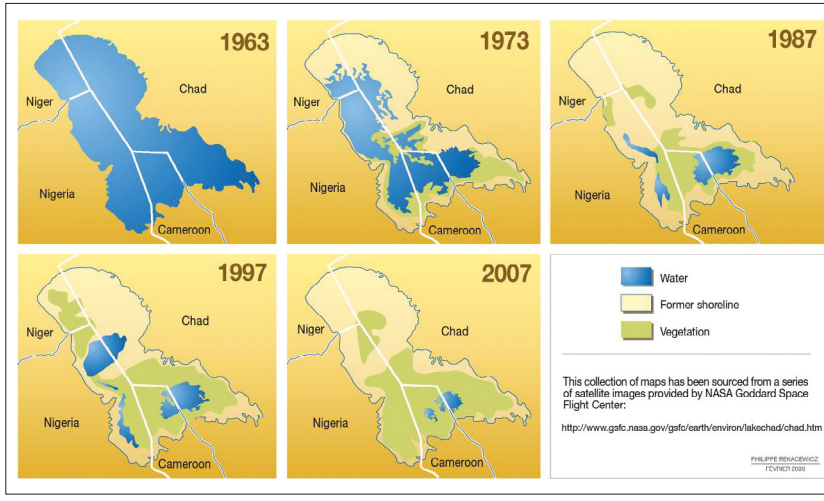

Figure 6. *The destruction of Lake Chad between 1963 and 2007*
Source: Tranquillius 2015

the fact that, in parallel, they have to fight the spread of epidemics and the activities of extremist groups.

The Lake Chad region is a good example of the link between climate change and environmental degradation, the rise of terrorism and general insecurity. In recent decades, the population has been growing at an extremely high rate, by more than 3% per annum. As a result, the area's population has grown to nearly 40 million, putting huge pressure on natural resources, particularly on agriculture, pastures and the remaining fish stocks in the lake. The local population is extremely poor, illiterate, malnourished and starving, aggravated by high unemployment and constant local conflicts. Lake Chad used to be their primary source of livelihood; the lake provided them with food, either through fishing or agriculture. However, a combination of decreasing rainfall and rising temperatures, as well as a shortening of the rainy season, drought and over-irrigation, has led to the lake drying up. Formerly, the lake's surface area was once 25,000 km^2 and now it is a tenth of that (Figure 6).

Boko Haram was established in 2002 and since then it has occupied significant areas in Nigeria, Chad, Cameroon and Niger. The organisation espouses an extremist Islamist ideology and pursues the broader goal of establishing an Islamic caliphate. The deaths of tens of thousands of people and millions of refugees can be attributed to it. In the course of its activities, it has acquired both legal (land, crops, trade) and illegal (drugs, arms and smuggling) resources. Boko Haram is a sorry example of how a terrorist organisation turns the negative effects of climate change to its own advantage.

Scarcity of resources, access to water and land, desertification and the resulting sandstorms, rapid drying out of cultivated land; each contributes to the loss of carrying capacity. These conditions only exacerbate the daily livelihoods of the people living there, who are already struggling under the terror of Boko Haram.

At the same time, the central governments of the Lake Countries have been weakened, which is another factor in the terrorist organisation's favour. The organisation exploits the social divisions in the region to project a sense of belonging to those who join it. Many of its newly recruited members are refugees who fled their homes for the above explained reasons. Boko Haram provides food and work to those who join it and who are open to extreme ideology in this desperate situation.[67]

Climate change, migration and conflict in Amazonia and the Andes[68]

The natural wealth of the Andes and Amazonia is a key resource. Amazonia is of central importance for the region's and the world's weather, and its biodiversity is of inestimable value. The mineral and energy resources of the Andes and Amazonia are also important factors in the global supply chain and in the region's macroeconomic growth. Amazonia and the Cerrado have also gained a key role in regional and global food security. Finally, the region's rivers and

[67] Koren–Behar 2020.

[68] Hoffman–Grigera 2013.

glaciers are essential for South America's energy security, drinking water security and agriculture. For these reasons, these areas demand increased attention.

There is a particular contradiction in this analysis. On the one hand, the study of climate change, migration and conflict or insecurity in this region is by its very nature more predictable than in other regions. While a large number of people faces danger in the region, the chances of major humanitarian disasters are lower than in, for example, Northwest Africa. Nevertheless, the trends are a cause for concern and deserve the attention of decision-makers.

On the other hand, as proven by experience, these peripheral regions are vast, far from the financial and political centres of the countries, and predominantly rural areas where people live in extreme poverty. Still, population pressures, as well as global demand for commodities are also bringing along rapid urban growth in the peripheries. The growth of cities now face the problem of providing sustainable, stable development in a difficult environment.

Although Brazil's urban regions in the Northeast, Southeast and South are also involved in migration and international drug trafficking, these are still not in the focus. Instead, we need to look at the lack of effective governance in the peripheral regions of the Andes and Amazonia, the deterioration of rural living conditions, the flourishing of illegal economies, the heavy influence of drug traffickers and non-state actors, and the serious burden it means for the population and the environment.

New strategies are needed to respond to these challenges comprehensively. The link between climate change and migration must be taken into account and a smart and sustainable security strategy promoted. Fighting organised crime and international drug trafficking, ensuring sustainable development and preparing for the effects of climate change are key challenges for the region in the coming decades.

The basic living conditions of the populations of Amazonia and the Andean periphery must be guaranteed to ensure social and economic stability in the region. Adequate governance must be ensured, capable of meeting the basic needs of the inhabitants, capable of regulating development and ensuring basic human security.

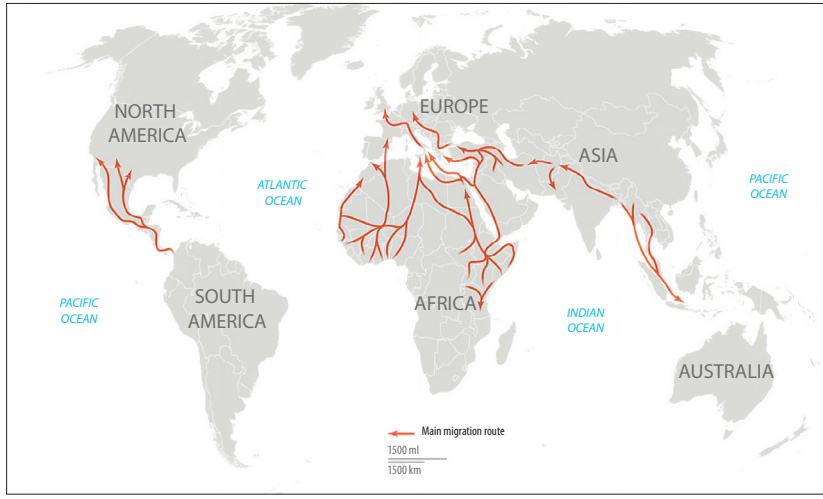

Figure 7. *Main migration routes*
Source: Abelovszky 2015

Governments must rise to these challenges and play the role of adjudicator. They have to balance between the interests of macroeconomic growth and extractive economy with equitable, sustainable developments. The stability of the region can only be safeguarded if the fundamental issues related to the sharing and use of natural resources are resolved in a *fair* way. Government involvement is also needed in climate change preparedness and adaptation, in addition to helping to address the consequences of natural disasters caused by climate change.

To the extent possible, regional governments should tailor development to develop infrastructure in more weather-resilient areas and discourage those who would operate in highly vulnerable areas. Finally, a continuation of an effective approach to renewable energy and hydropower, and an even more comprehensive, not necessarily military, response to drug trafficking is needed.

While these efforts are the responsibility of all governments in the region, the leadership in these projects falls primarily to Brazil and the United States.

It is essential for Brazil to protect and maintain Amazonia. Successful action against the international drug trade would increase social stability for both Brazil and the United States, especially in the big cities.

By leading such a regional programme, Brazil also has the opportunity to transform its global role in the 21st century in a peaceful, forward-looking way. And for the United States, these efforts provide an opportunity to renew and maintain its influence in this region. At the same time, it will gain a partner that can help preserve stability in the region and with which it can establish long-term and sustainable economic ties to avoid future crises.

Migration flows caused by climate change will be with us for a long time, perhaps permanently. At the time of writing, we do not see a solution that would make this problem manageable (Figure 7).

FURTHER OPINIONS

The Pentagon strongly believes that dependence on oil is problematic for a number of reasons, such as climate change, rising oil prices, supply disruptions, because they threaten the energy supply of the military forces. The *Operational Energy Strategy* document states:

> "Changes in oil prices will continue to be a budgetary challenge for the Department, and, given the state of the global oil market, disruptions in oil supply are likely, and increasingly likely, in the coming decades. The branches of military have already taken steps to increase the proportion of alternative liquid fuels."[69]

It is also a fact that fuel transport in a war zone can be lethal:

> "Today, half the cargo in convoys in Afghanistan is fuel. These convoys are particularly attractive targets for the enemy and are often attacked. Statistics show that the United

[69] US Department of Defense 2011.

> States loses one soldier in every 20 convoys, either in an IED attack or from direct fire. In 2012, more than 3,000 supply convoys moved in the country."[70]

According to *John McHugh* (US Secretary of the Army): "Anything we can do to get convoys off the road is a good thing."[71]

Thomas Fingar, a former member of the National Intelligence Council Board during the Bush presidency:

> "We believe that global climate change will have complex implications for the United States' national security interests over the next 20 years. The most significant impacts that will affect the United States will be indirect, and will be the knock-on effects of events in other countries. These could, in some circumstances, seriously threaten US national security interests. There is growing interest among policymakers in the issue, particularly whether climate change crises will become more widespread than the Darfur conflict and whether other violent scenarios could unfold."[72]

Retired Lieutenant General *Daniel Christman,* Retired Brigadier General *Steve Anderson,* Retired Brigadier General *Stephen Cheney* (USA):

> "Climate change will generate costs, because inaction has a cost. We can pay now by investing in clean energy technologies and common-sense measures to adapt to the consequences of a warming climate, or we can pay later in responding to disasters. These investments will not be cheap. Investing in floodgates, protecting vital ports, will cost billions. We must also recognise that climate change is a global problem that requires global solutions. By unleashing American ingenuity and entrepreneurial spirit to develop solutions, we can avoid the worst consequences of climate change while protecting our vital national security interests."[73]

70 US Department of Defense 2011: 5.
71 Tan 2015.
72 CCS Earth Institute 2008.
73 GlobalPost 2012.

Leon Panetta, former Secretary of Defense:

> "Climate change has a dramatic impact on national security: from rising sea levels to severe droughts and melting Arctic ice sheets, to more frequent and more devastating environmental disasters, all point to the likelihood that more intensive humanitarian assistance and disaster relief will be needed."[74]

Robert Gates, former Secretary of Defense:

> "I think it's an important national security threat, but I don't think it's a top priority. At the same time, if more and more countries start to cope with increasingly severe droughts, food shortages and famine could lead to political instability. So I think there are very real national security implications of what is happening to the climate."[75]

Retired General *Gordon R. Sullivan,* former Chief of Staff of the US, and retired General *Sherri Goodman:*

> "Climate change directly threatens our troops and our ability to defend ourselves in a dangerous world. Rising seas in the North Pacific threaten to flood the Ronald Reagan Ballistic Missile Defense Test Site,[76] which plays a strategic role in monitoring and tracking missile tests by North Korea, Russia and China. It is time to integrate climate change threats directly into our national security planning."[77]

Professor *John Schellnhuber,* former advisor to Angela Merkel:

[74] Femia–Werrell 2012.
[75] Werrell–Femia 2016.
[76] The Marshall Islands facility is responsible for ballistic missile tests and space warfare missions. According to a report commissioned by the Department of Defense, the area is expected to be flooded at least once a year until 2035 (Waldman 2018).
[77] Goodman–Sullivan 2019.

"The last 11,000 years have had an extremely stable climate. It is the only period during which human civilization has been able to emerge. I believe that a global, interdependent world cannot be led peacefully if we exit this period. Let us pray that we have a Lincoln or a Gorbachev to lead us."[78]

Opinions from the International Military Council on Climate and Security (IMCCS). General *Tom Middendorp,* Chair of the Council:

"Climate change poses a significant risk to global security that could lead to catastrophic situations in the coming decades. Security professionals must be prepared to prevent these threats and impacts."[79]

Michel Rademaker, member of the Council Executive Committee:

"When we think about ways to mitigate the risks of climate change, we need to understand that this requires complex action."[80]

General *Thomas D. Waldhauser,* commander of the United States Africa Command, said before a Senate committee in 2019:

"Changing weather patterns, rising temperatures, and dramatic variability in rainfall are contributing to drought, famine, migration and fierce competition for resources in Africa. As each group seeks land for its own purposes, violent conflicts may emerge."[81]

Retired Lieutenant General *Nagashima Jun,* Associate Professor, Graduate School of Security Studies, National Defense Academy, Japan:

78 Cambridge Climate Lecture Series 2018.
79 Expert Group of the International Military Council on Climate and Security (IMCCS).
80 IMCCS 2020.
81 Klare 2020.

> "Climate change is having a synergistic effect on the atmosphere, oceans, snow and ice, and the Earth's surface. It is therefore time for the military to place climate change amongst the new operational areas, as it has done for cyberspace and outer space, and to develop strategies that prioritise military approaches."[82]

Lloyd Austin, Secretary of Defense of the United States of America:

> "The Pentagon will immediately begin to assess the impacts of climate change and incorporate the results into the risk assessment process and strategic planning, thereby reducing the uncertainty that these impacts represent."[83]

Boris Johnson, British Prime Minister, at a UN Security Council meeting:

> "Climate change represents a threat to our security. The question is not whether we should address this issue, but what we should do."[84]

John Kerry, former US Secretary of State:

> "We are not taking climate change seriously enough; no country is doing its job in this area. In 2019, there are too many people in positions of responsibility who continue to call climate change a hoax."[85]

The 2021 NATO Summit also addressed this issue and a number of authoritative opinions were made known. On the third day of negotiations, climate protection and the preservation of racial diversity were at the heart of the discussions. Angela Merkel expressed her delight that "the US now once again abides by the Paris Agreement". This will make the G7's work on climate protection much easier and "[t]his is perhaps the symbolic message

[82] Nagashima 2021.
[83] Mehta 2021.
[84] COP26 2021a.
[85] Wettengel 2019.

of the Cornwall summit". "We will act, and we will act for a better world", because this is "more important than anything else in the aftermath of this pandemic". A fund of 100 billion EUR has been earmarked to draw down resources on these issues (*Tagesspiegel* reports that Germany wants to set a good example by increasing its support for climate-smart investments in developing countries from 4 billion EUR to 6 billion EUR by 2025). The G7 has committed to protect 30% of the land and sea surface by 2030. Participating countries have also committed to reduce their CO_2 emissions to nearly half of 2010 levels by 2030. Merkel stressed the need to work closely with China on climate change.[86]

Surangel Whipps Jr., President of the Pacific island nation of Palau, part of the Caroline Islands:

> "As large emitters with their insatiable appetite for advancement are continuing to abuse our environment, threatening our very survival [...] We see the scorching sun is giving us intolerable heat, the warming sea is invading us, the strong winds are blowing us every which way, our resources are disappearing before our eyes and our future is being robbed from us. Our future is being stolen from us. Frankly speaking, there is no dignity to a slow and painful death: you might as well bomb our islands instead of making us suffer only to witness our slow and fateful demise."[87]

Lukas Trakimavičius, an expert at the NATO Centre of Excellence for Energy Security:

> "Considering the stakes, European leaders cannot afford to hope for the best and go about with business as usual. Therefore, governments and international organisations need to double down on awareness-raising and resilience-building initiatives, and start preparing heir armed forces for the climate change challenges that are about to come."[88]

86 Reuters 2021.
87 COP26 2021c.
88 Trakimavičius 2021.

Sharon Burke, former US Deputy Secretary of Defense and security policy expert:

> "The biggest impact of climate change on national defence is that it weakens the resilience of societies. Military force is not designed to mitigate the effects of climate change through its traditional means, but these effects significantly increase the burden on military forces, as they are involved in disaster response, humanitarian operations and, in extreme cases, war operations. In other words, their demands are multiplied."[89]

Shira Efron, Senior Research Fellow at the Institute for National Security Studies (INSS) at Tel Aviv University, says:

> "Climate change is a strategic threat to national security in the classic sense of the word, and if we don't start to prepare for it now, we won't be ready at all."[90]

Retired Brigadier General *Michael Herzog,* Israel:

> "Our region is highly unstable in geopolitical terms, and if you add on top of it that it's a hotspot for climate change, it becomes a threat multiplier. This must be integrated into Israel's national security doctrine. Climate change is a faceless enemy that knows no borders and building fences will not be enough. We need regional cooperation."[91]

WHY SOLDIERS?

It may be noted that some of the opinions presented are from soldiers. Why are soldiers the ones who are concerned about climate change? The first reason is the way that people think about the future. Most operations experts, including soldiers, are trained to think ahead, to anticipate the range of problems

[89] Choi 2021.
[90] Surkes 2021.
[91] Surkes 2021.

that forces need to prepare for and then to try to identify the tools that may be needed to address those problems. This is the basis of their profession. Planning in the defence sector can take 18 to 20 years in terms of equipment, systems, logistics and training, so considerable effort is devoted to making an accurate assessment of the new needs that will arise in relation to normal defence requirements. In practical terms, this means that we are working today on capabilities planned for 2030, and these capabilities should, optimally, last until 2060.

The second reason is that modern militaries are dependent on fossil fuels. Where there is no political will or ability to invest in new technologies – such as nuclear propulsion, biofuels, solar and wind power – reliance on fossil fuels continues. Interestingly, even militaries that use nuclear power rely heavily on fossil fuels to operate aircraft or long-range ground vehicles. Energy security is therefore still a high priority in military planning circles when it comes to the challenges of climate change.[92]

As a good example, energy security concerns have been highlighted in the discussions between NATO and European Commission experts. The meeting on 13 December 2021 discussed the strategic dimensions of the Alliance's Eastern and Southern dimensions and the prospects for NATO's role in energy security. In the panel on the Eastern Dimension, there was a consensus among the speakers that Russia and Gazprom export their fossil fuels subordinated to the Kremlin's political goals ("Russian gas weapon"). In the Southern Neighbourhood (North Africa and the Middle East), two key developments are also working against NATO's energy security and overall security: the implementation of climate neutrality targets is reducing demand for gas and oil exports, while, with one or two exceptions, countries in the region have not started to prepare for the green transition or the post-transition economic setup. This is exacerbated by the fact that the countries of the region are more exposed than the average to the effects of climate change: according to some estimates, water scarcity and drought could reduce the region's GDP by up to 40%. Notably, in

[92] Barrie 2013.

Qatar, the average temperature rise is already reaching the 2°C that we are trying to avoid globally. By 2050, the Tigris River in Iraq is expected to be completely dry; countries in the region are at risk of dehydration, which will make the livelihoods of local societies essentially impossible.[93] This in turn will trigger new crises, the immediate security implications of which will be felt by both NATO and the European Union.

Experts from NATO's Emerging Security Challenges Section (NATO/IS/ESC) examined the possible role of NATO. In recent years, energy security has reached the strategic, decision-making level of NATO. This is reflected in the fact that the communique issued after the NATO Summit in June included a whole paragraph on this topic. The next report was adopted by Heads of State and Government at the Madrid Summit in 2022. As a result, energy security is becoming a more prominent aspect of NATO concepts and is increasingly present in training and preparation material. NATO's energy security policy has three pillars: (1) strengthening strategic "visibility"; (2) promoting adaptation to green energy transitions; (3) exploiting as fully as possible the synergies in the "climate and security" scenario.[94]

NATO's role in energy security aims to support the resilient energy supply of the population and national forces. This shows significant overlaps with NATO's efforts to strengthen resilience and address the security implications of climate change. The objective of enhancing energy security is to enhance NATO's resilience through the "green transition" that has been started in the Member States. A common interface between energy security and climate change scenarios is the use of renewable energy sources for military purposes. The aim is to increase the efficiency of NATO operations through the increasing use of renewable energy sources. Energy security also includes the extension of the oil pipeline to the east to supply NATO forces, which is currently under consideration by NATO experts on the basis of the terms of reference set by defence ministers in June 2021.[95]

[93] *Energiabiztonsági kerekasztal a NATO-ban* 2021.
[94] *Energiabiztonsági kerekasztal a NATO-ban* 2021.
[95] *Energiabiztonsági kerekasztal a NATO-ban* 2021.

The *Critical Decade Report 2013*, published by the Climate Commission (Australia), sums up the dilemma facing conservation:

> "The decisions we make from now to 2020 will largely determine the severity of climate change our children and grandchildren experience. [...] Carbon dioxide concentrations are at the highest level in over one million years. Most nations of the world, including Australia, have agreed that the dangers of a climate change beyond 2°C are unacceptably high. The temperature rise is already approaching 1°C above pre-industrial, nearly halfway to the 2°C limit.
>
> Most of the available fossil fuels cannot be burned if we are to stabilise the climate this century. The burning of fossil fuels represents the most significant contributor to climate change. From today until 2050, we can emit no more than 600 billion tonnes of carbon dioxide to have a good chance of staying within the 2°C limit. Based on estimates by the International Energy Agency, emissions from using all the world's fossil fuel reserves would be around five times this budget. Burning all fossil fuel reserves would lead to unprecedented changes in climate so severe that they will challenge the existence of our society as we know it today. It is clear that most fossil fuels must be left in the ground and cannot be burned."[96]

The dichotomy of competing views poses a serious problem for military planners, because we cannot assume that future forces will be able to operate the equipment and employ the capabilities that we have today. Perhaps that is why, in the UK and the US, research and experimentation with new fuels and operating principles has been a priority.

Other experts have also commented on this. "There is a reason why the armed forces and military leaders are so single-minded about the threat of weather change," said Professor John Schellenberg, a former adviser to Chancellor Angela Merkel.

> "The military [does] not deal with ideology. They cannot afford to: they are responsible for the lives of people and billions of pounds of investment in equipment. When the

[96] Steffen–Hughes 2013.

> climate change deniers took their stance after the Copenhagen summit in 2009, it is very interesting that the military people were never shaken from the idea that we are about to enter a very difficult period. This danger of the creation of violent conflicts is the strongest argument why we must keep climate change under control, because the international system is not stable, and the slightest thing, like the food riots in the Middle East, could make the whole system explode."[97]

There is another reason for it being important for soldiers to speak out in this area. This is credibility, which can also help to ensure that more and more people follow this approach, accepting the views of military leaders.

Soldiers have already experienced on numerous occasions that one of the effects of climate change is extreme temperatures, which directly affect the effectiveness of operations. During military operations in Iraq, temperatures in combat vehicles have reached up to 65°C, leading in many cases to dehydration, loss of consciousness, life-threatening heat exhaustion and death from heatstroke. In the summer of 2003, 50 out of 1,000 soldiers serving in Iraq suffered heatstroke; among British soldiers, 15% of all hospitalisations were for heatstroke, with over 800 soldiers dying from extreme temperatures.

The technical equipment and procedures were also subject to these influences. High temperatures affect data transmission, communication devices, sensors, target tracking accuracy, drone swarm control, autonomous systems and flight conditions.[98] Avoiding all these, reducing the effects, increasing operational safety has given military operations planners a lot of experience.

Last but not least, the military force is a decisive element of the complex system of security; in other words, in the final analysis (in the event of diplomatic and economic factors failing) it will be the decisive instrument in guaranteeing the security of a state.

[97] Carrington 2013.
[98] Stanley 2021.

Chapter 2

Climate Change Impacts and Military Force

Issues of the use of military force in a changing climate, the relationship between climate change and military security are areas that have not yet been researched in detail. The importance of this topic is already recognised, as the importance of studies has been mentioned in several places. Before going into the details, let us look at how experts see the attitude of major nations to the problem.

CLIMATE CHANGE AND THE ARMED FORCES

Climate change and its impacts have triggered public concern and concrete action in some governments. In some cases this includes national security actors, in particular the armed forces. While the practical knowledge base on the tasks of the armed forces and the changing operational environment is slowly accumulating, planning and foresight has already begun in the United States and the United Kingdom. In these two countries, some practical decisions have also been taken, particularly on mitigation of effects. Both countries have also taken decisions on reducing greenhouse gas emissions.

There are, of course, some distinct differences. In the United States, the military – particularly the Navy – is taking the initiative in climate change decisions. Past and present naval leaders have called for the impacts of climate change to be taken seriously. This at a time when official US policy has long been sceptical about climate change. Compared to the Navy, other branches of the armed forces have woken up later and approached the problem with different priorities. The primary goal of the Air Force and ground forces is

to reduce energy use and increase energy security, one of the consequences of which is a reduction in greenhouse gas emissions.

In the UK, the link between climate change and energy policy is not as strong as in the US. The UK Armed Forces have developed a detailed plan that includes emission reduction pathways, the potential impacts of climate change and the task of preparing the Armed Forces to meet the challenges. Even so, the UK force has previously been rather passive.

Although there are a few small countries whose armed forces have taken a serious interest in the effects of climate change, in the past the issue has not reached the armed forces of most countries. Some have had different priorities and others have deliberately kept soldiers away from the issue, at least on the surface. Russia and China have been good examples.

In these two countries, less attention seems to have been paid to the impacts of climate change in the planning process. In the case of Russia, this was understandable, as there were many other, more pressing problems for decision-makers to address. The first of these is the rebuilding, modernisation and reform of the Russian armed forces. In connection with the Arctic Circle, the modernisation of the armed forces and the response to the effects of climate change were then linked. Development proposals in this area have been made on the basis of very conscious decisions and are now a matter of priority in these countries as well.

In China, the military leadership is acutely aware of the impacts of climate change on the role of the military, operational requirements and the assets needed. Publicly, however, these issues are at a standstill in the context of an increasingly intensive military involvement in disaster response, because the official Chinese position is that climate change is a fact but not a security problem.

The armed forces are not only the sufferers of climate change, but also its cause. In this sector, reducing emissions has become a priority. While in the US and the UK the military have become active participants in mitigation efforts, it is less clear whether this will happen in China, and unlikely to happen in Russia because of low energy prices. The following facts show that emissions are a serious problem in the operation of the armed forces and related military production:

- Carbon dioxide emissions from military force and the related defence industry amount to 445 million tonnes CO_2 equivalent (2017), which is higher than the annual greenhouse gas emissions of the whole of Italy and close to the total greenhouse gas emissions of the UK (505 million tonnes CO_2 equivalent) and France (482 million tonnes CO_2 equivalent).
- The military and defence industries account for at least 1% of total greenhouse gas emissions, but this figure could be as high as 5%. If the world's militaries were ranked as one country, it would be the world's 29th largest oil consumer, just ahead of Belgium or South Africa. Put another way, it is half the oil consumption of the world's 5th largest economy, the UK, or the 6th largest, France.
- The total carbon dioxide emissions of the EU15's military and defence industry are 60 million tonnes of CO_2 equivalent, the same as Ireland's emissions and roughly 2% of the EU15's total greenhouse gas emissions in 2017. Carbon emissions represent the total carbon emissions of the EU15.
- The total greenhouse gas emissions from the nine-year war in Iraq (2003–2011) amounted to around 254 million tonnes of CO_2. This is slightly more CO_2 emissions than the 14th largest economy in the world, Spain, produced in 2016, and only a quarter less than what the 6th largest economy, France, produced.[99]

UNITED STATES

Respected US military experts – retired generals – see global warming as a serious threat to US security. Their study entitled *National Security and the Threat of Climate Change* addresses the risks to US security interests posed by the effects of warming.[100]

According to military experts, climate change in politically unstable regions would clearly help extremist forces and terrorism. The study draws

[99] ClimeNews 2021.
[100] CNA 2007.

on predictions in climate reports that global warming will cause more severe storms, droughts and floods, and that melting Arctic and Antarctic ice sheets and glaciers will raise the level of the world's oceans. One consequence could be mass displacement, causing tensions and conflicts at national borders, while another could be an increasing demand on international rescue forces, including military forces and assets. At the same time, fighting over drinking water reserves could erupt.

According to the authors, these scenarios imply that the US military will face a much greater and more complex task than before. They also highlight the difficulty of adapting to changed circumstances, given the size of the military and its existing assets and fixed bases. As an example, they point to changes in the Arctic region, which have already altered some shipping routes and would require a more substantial naval capability to protect US interests there.

The impact of extreme weather conditions (heat, intense precipitation, dust) also poses a serious threat to advanced weapons systems and military bases (Figure 8). The report cites the example of the US base at Diego Garcia, the operations of which are being made more difficult, or at worst impossible, by the continued rise in sea levels (more than one metre so far). Rising sea levels are threatening a total of 30 military bases. In 1992, Hurricane Andrew damaged an air base in Florida so badly that it is still inoperable. In 2004, Hurricane Ivan wiped out the Pensacola air base for almost a year. Climate change is also causing serious problems for the operation of the main US naval base in Norfolk. According to an expert report, the base is the fifth most vulnerable military installation.[101]

A 2018 survey examined 79 key military bases. The report found that 10 are at risk of recurrent flooding over the next 20 years, being close to the sea. Thirty-six military bases are vulnerable to wildfires and a further seven are at increased risk of fire. More than half of the bases surveyed could be damaged by drought, making water supply difficult.[102]

[101] Foley 2012.
[102] Office of the Under Secretary of Defense for Acquisition and Sustainment 2019.

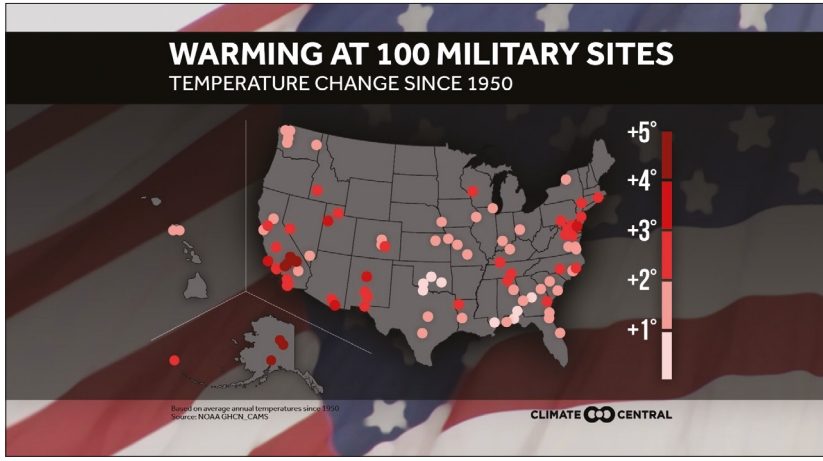

Figure 8. *Temperature variation for some military bases 1950–2018*

Source: Climate Central 2018

Extreme weather and climatic conditions also affect military operations. In the war in Iraq, several operations had to be postponed or cancelled due to sandstorms, the lifespan of technical equipment was reduced and repair costs increased significantly. The sandstorms also made it difficult to deliver supplies, which in particular compromised fuel supplies. In a war in which 9 million litres of fuel were moved around the theatre of operations every day, any weather anomaly was and is a threat to the success of operations.

The evaluations also agree that the military will have a greater role to play in the future in dealing with disasters caused by climate change.

This, together with the cross-border impact of disasters, requires a level of cooperation that goes beyond what has been achieved so far. Only with such cooperation can the existing capabilities be used effectively, and only in this way can specialised forces or assets existing elsewhere be accessed quickly.

Rescue and relief operations must be carried out in extreme climates, in difficult climatic conditions and in different cultural environments. This increases the value of capabilities such as water supply, air transport capacity,

Table 11. *Vulnerability of resupply convoys (number of victims)*

	2003	*2004*	*2005*	*2006*	*2007*
Afghanistan	5	11	33	64	75
Iraq	531	994	618	452	263
Total victims	*536*	*1,005*	*651*	*516*	*338*

Source: AEPI 2009

civil–military cooperation, specialised preparedness and technical equipment, and rapid response ability.

US ground troops are present in many parts of the world with hundreds of thousands of troops, tens of thousands of technical devices and hundreds of military installations. These figures also represent a significant environmental burden, so the ambition to reduce carbon emissions by 30% by 2015 is not a coincidence. To this end, the size and equipment of some training bases and training areas have been reduced by orders of magnitude. They are increasingly replacing existing technologies with environmentally friendly and recyclable materials.[103]

Given the high vulnerability of resupply convoys, reducing their number is worth considering.[104] According to past operational statistics, in every 24 convoy someone is injured or killed in the area of operations. Currently, the convoys are manned by 120–130 heavily armed soldiers. In Afghanistan,

[103] In June 2008, a research programme was launched to study carbon emissions from a military base at Fort Carson, Colorado. The data show that the base's annual emissions are equivalent to those of a city of 25,000 people, or 205,000 tonnes of carbon dioxide per year (Zabarenko 2008).

[104] The figures speak for themselves: the death of a Marine on 15 June 2006 brought the total number of US soldiers killed in Iraq to 2,500, while 18,490 were wounded. British casualties totalled 113, with an additional 112 allied casualties. The biggest problem and a significant percentage of casualties is caused by the explosion of roadside bombs, which shows the vulnerability of convoys. This is the reason why the development plans of the US Army include a bomb disposal squadron at brigade level, in addition to the technical field engineer squadron (Miller–Draker 2006: 11).

15 million litres of fuel are used every month in military operations, which represents a huge transport task and a corresponding risk.

It is worth looking at the statistics for the period 2003–2007, which show the particular vulnerability of convoys. Table 11 shows the number of victims of attacks on fuel and water resupply convoys.

"Less fuel, less risk," say the experts, and they are looking at alternative, renewable energy sources such as wind and solar power. This is because more than 85% of the energy used at military bases in Kuwait, Iraq, Afghanistan and Djibouti is used to cool living and working quarters and communications equipment. As the continuous cooling of these is essential, other saving solutions must be found. One method is to insulate the tents, which can reduce energy losses by 45%. By the end of World War II, the activities of an American soldier required four litres of oil equivalent energy a day. This figure rose to 33 litres during the Vietnam War and 81 litres during the first Gulf War. In 2011, the Pentagon spent 15 billion USD to meet the fuel needs of military operations.[105]

Specialised equipment has also been developed to support the activities of each branch of the armed forces in the theatre of operations. One such development is the use of flexible photoelectric devices applied to the surface of the tent, which is otherwise partially insulated. These are used to power and charge various portable electronic devices. They can also be used to recharge, where necessary, the batteries used in the sub-unit's info-communication and fire control devices, rechargeable batteries or the increasingly widespread fuel cells. Smart grids are also being developed in camps, notably in the US and the UK, to allow the connection of different types of electricity generating equipment, i.e. diesel generators, solar panels, wind generators, to a common grid and to allow fuel-efficient operation.

The fuel consumption of vehicles is also a major challenge. The contradiction of "lighter vehicle – lower fuel consumption – lower protection" can be resolved by new, complex technologies that point the way towards lighter

[105] Végvári 2021: 20–25.

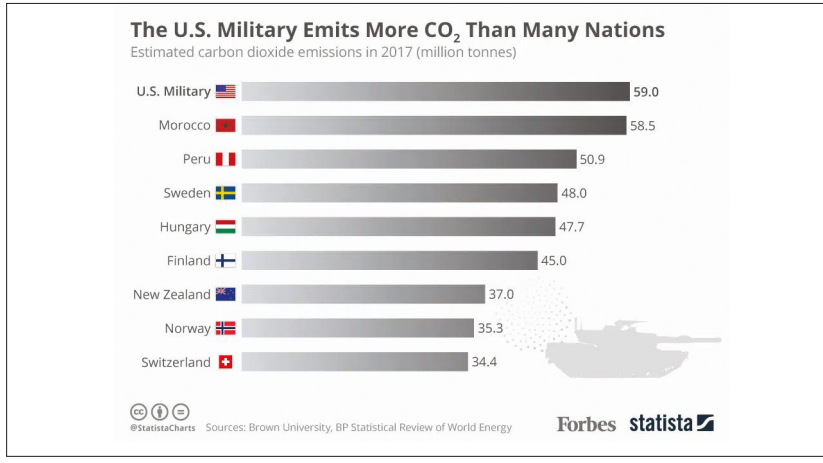

Figure 9. *Comparison of US military carbon emissions with some countries in 2017*
Source: Lewis 2021

but protective armour. Significant savings can also be expected from the mass uptake of hybrid military vehicles.

Since 1.5% of the total US energy use can be attributed to the defence sector, the potential savings and associated emissions reductions can be demonstrated at the national economy level. The military could do with the latter, as in 2017 alone it emitted enough carbon dioxide to rank 47th on the list of the largest emitting countries (Figure 9).

The US Department of Defense's intention to transform and reduce energy use is therefore understandable. Their goal is to have 25% of military energy use from renewable sources by 2025. In military circles, despite decades of awareness and use of renewable energy sources,[106] the oil price boom has accelerated the pace of savings programmes. A 10 USD increase in the price

[106] Nellis Air Force Base (Nevada) has the largest solar array in the United States, a geothermal thermal power plant has been powering an airbase in California for two decades, and wind farms operate at Guantánamo Bay (Cuba).

of a barrel of crude oil would mean an annual increase of 1.3 billion USD in spending for the Department of Defense.[107]

In the coming years, energy use is to be reduced by 10–20%, which could bring very significant savings in terms of annual costs (11 billion USD in 2005, 14 billion USD in 2008).[108] Specific targets for energy efficiency and the use of renewable energy sources have been set for the different branches of the armed forces. For example, for the ground forces, a 25% reduction in fossil energy consumption by 2015 compared to 2003 levels has been targeted, and by 2025, 25% of total consumption should be met from renewable sources. A separate pilot programme for biofuels has been launched for the air force, although it is likely that this will be followed by increased use of second-generation biofuels from cellulose sources.[109]

Recent computer simulations and intelligence agency studies have both concluded that vulnerable regions, particularly in sub-Saharan Africa, the Middle East, South and Southeast Asia, will face food shortages, water supply crises and catastrophic floods over the next 20–30 years, which will require US humanitarian assistance or military response.[110] The National Defence University has modelled the consequences of a massive flood in Bangladesh that would cause hundreds of thousands of people to flee into neighbouring India. There would be regional conflict, the spread of infectious diseases and severe damage to infrastructure.

The debate on global warming has so far focused on how to replace fossil fuels, how to reduce greenhouse gas emissions and how to encourage negotiations for an international climate convention. But now, more and more policy-makers are concluding that rising temperatures, rising sea levels and

[107] Woodall 2008.

[108] Woodall 2008.

[109] Cox et al. 2020.

[110] It should be noted here that military responses may also differ depending on whether they impose their will by force or not. A good example of the former is the human rights violations in Kosovo in 1999, or a humanitarian crisis like the one in Somalia in 1991. Examples of the second are the assistance provided during natural disasters (Mozambique, 2000) or the response to the humanitarian crises in Zaire/Mozambique in 1994.

melting glaciers are a direct threat to national interests. Proponents of this view say that unless the United States leads the world in reducing fossil fuel consumption and thus global warming gas emissions, global environmental, social, political and even military crises could emerge that the country must urgently address.

Former Secretary of State Hillary Clinton, as a senator, urged Congress to take climate considerations into account in strategic planning. The department's climate model is based on the US Navy and Air Force weather programmes and other government climate research. The Pentagon and the Department of State have been studying the problems of dependence on foreign energy sources for years, but are only now beginning to incorporate the consequences of warming into long-term planning. The Pentagon has developed a climate chapter in its four-year defence programme, and the State Department is preparing a similar chapter in its parallel programme. Although military and intelligence planners have been aware of the challenge of climate change for a few years, it is only the Obama Administration that has begun to address it as a central policy issue.

The National Intelligence Council, which coordinates amongst US intelligence agencies, has concluded that climate change-induced storms, droughts and food crises will create numerous emergencies. The inevitable relief efforts could put severe strains on US military transport and support capabilities, reducing the strategic depth needed for combat operations. This will also affect the international balance of power.[111]

In 2019 a document summarising the direct and indirect impacts of climate change on the defence sector was published.[112] It clearly states that the impacts of climate change are considered a national security issue. 79 military installations were assessed for impacts and their possible consequences, with a particular focus on the occurrence of flooding, drought, desertification, permafrost melt and fire damage.

The report concludes that the functioning of defence installations is seriously affected by a changing climate. On the one hand, this impact jeopardises

[111] National Intelligence Council 2021.

[112] Office of the Under Secretary of Defense for Acquisition and Sustainment 2019.

the continuity of operations, increases maintenance costs and makes it essential to increase the resilience of these installations. The Ministry of Defence is spending considerable sums to improve the durability of military installations, but the efficiency of these measures is still questionable. The 67 million USD allocated for 2020 has been used, but they did not prepare for the measurement of the improvements' impacts.[113]

The United States has also produced an analysis that sets out in detail the impact of climate change on military force and the possible (necessary) responses.[114] These are forward-looking ideas, especially in the light of the fact that they come during the presidency of Trump, who is not known as a leader in the fight against climate change.

The study lists in detail the areas and ways in which the change has an impact on the day-to-day functioning of military forces. The essence of their findings is as follows:

– Rising sea levels, changes in water and food security, and an increase in the frequency of extreme weather events are triggering significant mass migrations, which pose direct security risks. The situation is aggravated by the fact that these events tend to affect already poorer regions where the state is unable to manage these changes. This in turn leads to a need for increased military force to support humanitarian operations and, in extreme cases, to intervene to suppress violent acts.
– One of the consequences of climate change is the emergence of freshwater scarcity, i.e. reduced access while increasing demand due to rising temperatures. This also affects the supply of water to the military, as the demand for water increases by orders of magnitude. This places a significant strain on logistics, especially in mission tasks.
– This warming creates the right conditions for the emergence of new, previously unknown or locally uncommon infectious diseases. In this case, health support for the armed forces can play a key role in the care of both soldiers and civilians.

[113] Myers 2020.
[114] US Army War College 2019.

- The melting of the Arctic ice and the retreat of the permanent ice sheet increases competition for the minerals that become available as a consequence of the melting. A further consequence of this change is that northern trade routes are becoming more valuable, leading to strategic changes in world trade and the maintenance of military balance. This will require the development of new military capabilities.[115]
- Warming could also cause immediate problems in the US home territory. Overstretched energy grids could collapse from time to time, posing economic risks.
- The material resources available to the military are also affected by the emergence of climate change impacts in public thinking. The defence sector must be at the forefront of more environmentally conscious thinking, reducing emissions and protecting the environment. Intensive development must be initiated in the areas of doctrine development, training system restructuring, procurement of military equipment and rethinking cooperation. All this can help to set an example as a leading organisation and thus improve its image and access to resources.[116]

With the Biden Administration taking office, a major change at the government level is likely, as the first statements suggest. The president has called for a national coalition to combat climate change, making it a priority to improve the area. Among other things, he wants to make millions of buildings across the country energy efficient. He also pledged to do his utmost to make US electricity generation zero CO_2 emission by 2035. Biden also envisaged expanding electric mobility.[117]

[115] The first elements of this have already appeared in the military forces. "We are looking at the creation of multi-domain operations in the greater region, as well as the creation of a brigade with Arctic capability and combined capabilities," said General James C. McConville, Chief of Staff of the US Army, at a conference at the UN in January 2021. But already part of the new polar strategy is the deployment of four B-1 strategic bombers and their 200 crew to Norway (Székely 2021).

[116] The cost of running military bases alone, i.e. bases, airfields and training centres, which cover more than 100,000 km^2 around the world is up to 200 billion USD a year (Székely 2021).

[117] MTI 2020.

In his first major speech at the Department of State, US Secretary of State Antony Blinken called the way the United States handles its relationship with China, a central part of the new US administration's foreign policy, the "biggest test" facing the US. He also cited the fight against climate change and the pandemic as the main foreign policy challenges facing the US administration.[118] All these governmental efforts will also have an impact on defence policy, where climate change and security issues are expected to gain momentum, as are efforts to develop military force in this direction.

In February 2021, President Biden commissioned the analysis of the national security implications of climate change. The work was coordinated by the Office of the Director of National Intelligence, which led to a report.[119] Its key findings are as follows:

- Geopolitical tensions will increase as confrontation between countries over how to accelerate the net greenhouse gas emission reductions needed to meet the Paris Agreement targets. At the heart of the debate will be who is responsible for acting and paying, and how quickly. Countries will compete for control of resources and dominance over new technologies for the clean energy transition. China and India will play a critical role in setting the temperature rise trajectory.
- The growing physical impacts of climate change will exacerbate tensions between countries as they seek to secure their interests. For example, melting Arctic ice will make new resources available, increasing competition to exploit these resources. As temperatures rise, the risk of conflict over freshwater and migration will increase, especially after 2030, and countries will unilaterally test and apply procedures, which could result in new disputes.
- The physical impacts of climate change will be felt most in developing countries, which are also the least able to adapt to these changes. These impacts will increase the potential for instability and internal conflict in these countries, which may require diplomatic, economic, humanitarian and military intervention by the United States.

[118] Molnár 2021.
[119] National Intelligence Council 2021.

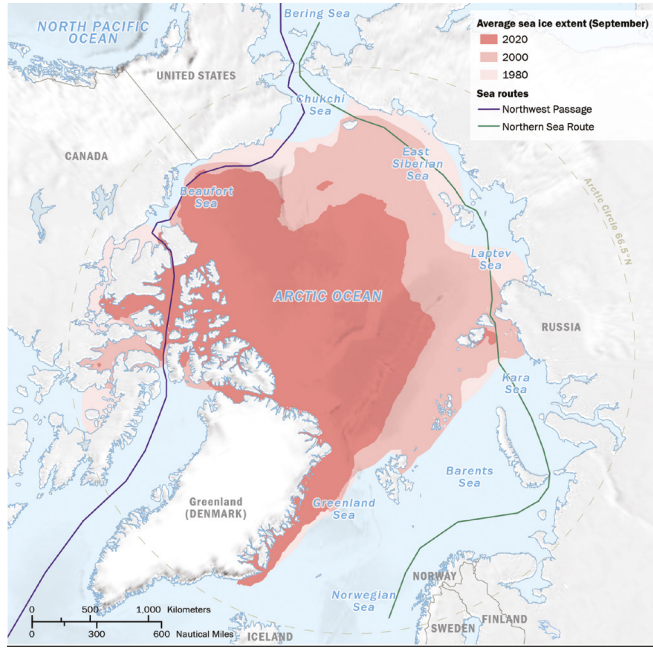

Figure 10. *Trade routes opening up with the shrinking ice cover*

Source: Kiss 2021

The report identifies China, North Korea, Iran and Russia as high risks to US national security.[120]

In connection with China, it highlights that variable rainfall could exacerbate the country's north–south imbalance in water supply, challenging less-watered farmland in the northeast and increasing the motivation to build dams. However, the report says that China will have the financial and technological resources to meet these challenges.

[120] Kiss 2021.

North Korea's poor infrastructure will weaken its ability to cope with increasing floods and droughts, exacerbating the country's chronic food shortages. Increasing extremes of weather could reduce the water stored in reservoirs during droughts, while crushing infrastructure during the rainy monsoon season.

Iran is facing increasing droughts, heatwaves and growing desertification, which is reducing food production and increasing import prices. This could lead to instability and local conflicts.

Russia's infrastructure will be damaged by melting permafrost, more frequent and larger forest fires and increasing erosion. Droughts are also expected in areas under cultivation. At the same time, Russia stands to benefit significantly from the opening of trade routes in the Arctic (Figure 10).

UNITED KINGDOM

The UK Climate Change Programme was adopted in 2006. It was along the lines of the principles and objectives set out by the then Chief of the Defence Staff, General Jock Stirrup, who said:

> "Climate change is an unusual and perplexing challenge for military force, compared to the usual military challenges. Warming temperatures and changing precipitation are making food and water supplies particularly difficult in areas such as Sudan and other parts of Africa. This destabilises these areas, which can lead to unrest and ultimately to the use of military force. In addition, the army has a role to play as a carbon emitter, as it is responsible for 1% of the country's total emissions. As a consumer, the defence sector consumes 32 billion USD worth of electrical energy annually, which can also be reduced through appropriate improvements, the introduction of energy-saving solutions and a rethinking of training methods and equipment. Our goal is to reduce defence sector emissions by 30% by 2012."[121]

[121] Rácz 2008: 75–84.

Rear Admiral Neil Morisetti, the Department of State's special envoy, believes that governments should not wait for complete certainty on the effects of climate change. Climate change poses a serious threat to the UK's national security and resilience to cyberattacks and terrorism, says the senior military leader.[122] In his opinion, climate change is one of the biggest risks we face in the 21st century, especially as it is a global threat and will affect everyone because of interdependencies.

He argued that climate change is increasing the threat at hubs in the global trade network, such as the Strait of Hormuz, through which much of the world's oil and gas transport flows. Increasing drought damage, storms and floods are exacerbating tensions over water, food, population and security in regions already prone to conflict.

Morisetti's message is simple and tough: the areas of greatest global stress and the strongest impacts of climate change are roughly coincident.

Just because it is happening 2,000 miles away does not mean it will not affect the UK in a globalised world, whether it is because food prices go up, or because increased instability in an area – perhaps around the Middle East or elsewhere – causes instability in fuel prices.

"In fact it is already doing so," he added, noting that Honda's UK car plants had been forced to switch to a three-day week after extreme floods in Thailand cut the supply chain. Computer firms in California and Poland were left short of microchips by the same floods.

> "In Afghanistan, where we have had to import all our energy into the country along a single route that has been disrupted, the US military have calculated that for every 24 convoys there has been a casualty. There is a cost associated in bringing in that energy in both blood and money. So to drive up efficiency and to use alternative fuels, wind and solar, makes eminent sense to the military,"

He said, noting that the use of solar blankets in Afghanistan meant fewer fuel resupply missions.

[122] Carrington 2013.

> "The principles of delivering your outputs more effectively, reducing your risks and reducing your costs reads across far more widely than just the military: most businesses would be looking for that too."[123]

Morisetti's former employer, the Ministry of Defence, agrees that the climate threat is a serious one. As it can be read in the last edition of the *Global Strategic Trends Analysis:*

> "Climate change will amplify existing social, political and resource stresses, shifting the tipping point at which conflict ignites [...]. Out to 2040, there are few convincing reasons to suggest that the world will become more peaceful."[124]

In the UK, climate change assessments cover a very wide range of issues. Of particular note is an analysis commissioned by the Ministry of Defence and published in 2020, in which the authors provide a comprehensive picture of the links between climate change and security.[125] In this paper, the impacts on defence are organised around nine clusters:

– *Action plans and doctrines:*
  - there is a growing need for action plans, doctrines and plans that take the impacts of climate change into account
  - increasing the frequency and therefore the importance of programmes already known and used (military support to civil authorities, military support for disaster response)
  - take on the role of coordinating the efforts of official bodies and organisations at government level in a single action plan
– *Training:*
  - the importance of coordinating training programmes in space and time will increase as climate change limits such capacities

[123] Carrington 2013.
[124] Ministry of Defence 2014.
[125] Cox et al. 2020: 1–45.

  - the timing and content of training will change significantly due to changes in health and safety requirements caused by climate change
  - the demand for certain capabilities, namely technical support, search and rescue, evacuation, construction and air traffic control will increase
  - preparing for the effects of climate change increases the importance of training (war games, planning exercises, simulation) and requires a broader range of participants
- *Staff:*
  - working in extreme climatic and weather conditions has an impact on the physical and mental well-being of staff
  - climate change may have an impact on the spread of communicable diseases, which will require increased health support
- *Military installations:*
  - military installations both in the UK and overseas are increasingly exposed to the effects of climate change
  - rising temperatures have a detrimental effect on the movement of personnel and technical equipment, making it increasingly challenging for military forces
  - rising temperatures can affect the efficiency of military equipment, increasing the need for air conditioning and thus energy consumption and emissions
  - climate change also affects civilian elements of critical infrastructure (supply systems), the inefficiency of which directly affects the performance of military tasks
- *Defence materials and military equipment:*
  - increasing temperature reduces the efficiency of existing equipment, so improvements are moving towards devices that are less sensitive to temperature
  - extreme weather can alter access to rare minerals, which can lead to an armed conflict
  - the changed requirements for the storage of military equipment due to climate change will lead to significant cost increases

    - civilian infrastructure critical to military operations will also be under increased pressure from climate change, which will become an additional challenge
- *Information:*
    - the need to develop a vision for the role of the defence sector in mitigating the adverse effects of climate change is being appreciated at both national and international level
    - demonstrating this will help to build support from key decision-makers for such a defence effort and may also provide additional resources for implementation
    - an additional benefit is that the strategic-level initiative serves as a message to both allies and adversaries
    - avoiding the possibility that adversaries could become more actively involved in addressing the challenges posed by climate change, as this could have a strategic impact on the UK's international diplomatic leverage
- *Organisation:*
    - the challenges posed by climate change will also force a rethink of the military mission system
    - as climate change mitigation involves a wide range of public and civil society bodies and organisations, it is essential to discuss and organise cooperation and task-sharing with them
    - the changing operational environment requires the involvement of new technical, diplomatic and humanitarian experts
- *Collaboration skills:*
    - as climate change will affect all areas, it is essential to create the conditions for a high level of cooperation with emergency services, other governmental and non-governmental bodies, international actors, primarily NATO
    - the capabilities of allied countries are also affected by climate change, which directly affects NATO's capabilities; the latter makes it inevitable that the problem will be tackled at alliance level, which gives the UK the opportunity to take the initiative in this area

– *Logistics:*
  - the destruction of infrastructure in disaster-affected areas makes them more difficult to access
  - as the temperature rises, the demand for critical supplies (water, fuel, medicine) increases and the need for cooling capacity rises
  - the increased frequency of flooding will increase the need for surface vessels, helicopters and mobile communication equipment to provide command liaison and rescue
  - increasing involvement in disaster response will increase the cost of logistical support and imply a more intensive involvement of medical, air transport and traffic management resources in operations
  - the opening up of Arctic and Northern territories and routes will have an impact on trade transport routes, including defence transport, as shown by the growing international interest in these areas

Building on this, the study provides a clear framework for the challenges facing the Ministry of Defence in responding to the challenges posed by climate change. This response must be both consistent with government ambitions and provide effective support for all aspects of defence development. To get there, the following steps need to be taken:[126]
– summarising and assessing the available knowledge on the impacts of climate change
– analysing and evaluating government efforts, and exploring the links at the societal level
– identifying responses to challenges in the defence sector
– prioritising and weighing the negative impacts of climate change
– the formulation of policy measures
– monitoring and evaluating the impact of the measures

[126] Cox et al. 2020: 1–45.

In March 2021, Prime Minister Boris Johnson published the results of the most significant review since the Cold War, setting out the UK's foreign, security, defence and international development priorities up until 2030. The top priority on the international stage is to address climate change as a security challenge. The aim is for the UK to be the world's leading power in green technologies by 2030, supporting emissions reductions.

According to the report, migration pressures could increase in the coming decade, given the world's population growth, climate change impacts and conflicts, and economic crises. The UK must respond to these challenges jointly with its international partners. The changes will also affect the armed forces, which could be deployed abroad for longer periods and in larger numbers, with the risk of a reduction of up to 10,000 troops. For the first time, the report formally states that such challenges cannot be tackled alone. Indeed, the handling of the Covid pandemic has shown that international commitment to cooperation in a crisis is fragile. The same is true in case of climate change, which, on the one hand, is a security problem in itself and, on the other hand, intensifies other risk factors (loss of biodiversity, migration, poverty, terrorism, increasing number of natural disasters, water conflicts), in areas (sub-Saharan Africa, South and East Asia) that are already facing a number of problems. The document emphasises the commitment of the military to support disaster response, in close cooperation with civilian actors.

The importance of the issue I am examining is shown by the fact that the term 'climate change' is mentioned 90 times in the 114-page document.[127]

Climate change policy is one of Prime Minister Boris Johnson's top personal priorities, including the success of the UNFCC COP26 conference in Glasgow in November 2021, which was a key event in the UK's foreign and economic development policy. The UK has set new and more ambitious climate targets than ever before, with greenhouse gas emissions to be cut by at least 68% by 2030, compared to 1990 levels. It will therefore be the first

[127] *Global Britain in a Competitive Age. The Integrated Review of Security, Defence, Development and Foreign Policy* 2021.

country to make a substantial and necessary national undertaking, which is the core of the Paris Agreement.

Prime Minister Boris Johnson has announced a 10-point "green industrial revolution" climate action plan. The announcement fits in with the green transformation plans signalled by the "build back better" recovery from the Covid crisis. Focused on energy, transport, conservation and innovation, the announcement says the transition to a green economy will create 250,000 British jobs with 12 billion GBP of government support and an estimated three times as much private sector investment.[128]

Reducing emissions also poses new challenges for the military. Hybrid or pure electric vehicles are being a priority in development and procurement, and the role of renewable resources is increasing. The wider use of drones, robots and distribution of simulators fits into this logic.[129]

CHINA

When we talk about the Chinese army (officially known as the People's Liberation Army of China), the first thing that comes to mind is the modernisation efforts of the past decades. These have now resulted in China's military strength being outstanding in both numbers and quality. The transformation over the past decade has been twofold: on the one hand, the former Chinese ground forces of several million have been significantly reduced (there are still 2 million of them in all), while there have been quantum leap developments in the quality of all forces. China is now capable of space warfare, with the first Chinese Lunar Roving Vehicle (LRV) landing on the dark side of the moon in early 2019. The navy is the fastest growing Chinese force: by 2030, it will have more than 500 ship units, well in excess of the number of units planned for the US Navy by then. The number of nuclear submarines is growing at a similarly dynamic pace, and will also surpass the US force in a few years.

[128] COP26 2021b.

[129] In more detail see UK Ministry of Defence 2021.

Although Chinese aircraft carriers are not yet major players, development in this area has started.[130]

In addition to traditional military tasks, these forces are also ideal for disaster response. Rescue and disaster response tasks were already included in the training programme of the Chinese armed forces in 2002. After the Yunnan earthquake (2014), when thousands of troops were sent to the area, the idea of "a new, historic mission for the Chinese army", as advocated by Hu Jintao, gained ground.[131] This included active military involvement in humanitarian and disaster relief operations. In the 2013 *White Paper* on China's Armed Forces, he listed military operations outside war as the third priority of the armed forces.[132]

Natural disasters are not unknown in China, with floods, earthquakes and storms hitting the country regularly. Over the past decade, China has placed greater emphasis on strengthening its disaster response organisational framework to ensure a faster and more effective response. Military involvement in disasters pays off many times for the army. First, it provides additional resources, second, it boosts training and confidence, and third, it increases the acceptance of military force in the country.[133] A good example is the floods of 2021.

At the same time, China is mobilising more and more forces to protect against disasters abroad and to provide military support for humanitarian operations. Many have accused the country of subordinating these operations to propaganda to demonstrate the superiority of the Chinese political establishment. According to their critics, these operations are also being used by the country to gather information and spread its political views. At the same time, partners, including the United States, are increasingly developing

[130] See http://english.chinamil.com.cn/china-military/node_87057_2.htm.

[131] Hu Jintao is a Chinese politician and statesman, General Secretary of the Communist Party of China from 2002 to 2012, President of China from 2003 to 2013 and Chairman of the Central Military Commission from 2004 to 2012.

[132] PRC Information Office of the State Council 2013.

[133] Tiezzi 2014.

Figure 11. *Chinese military humanitarian engagement abroad 2002–2015*

Source: Southerland 2019: 9

cooperation with Chinese forces in this area, including joint exercises and training and information exchange.

China's involvement in humanitarian operations at home and abroad is intensifying, and the growing number of disasters is only one reason for it. The diplomatic benefits are not to be dismissed, and projecting the image of a responsible superpower is also a legitimate objective (Figure 11).

CANADA

In the summer of 2007, global warming made the most direct shipping route between Europe and Asia navigable again, namely the legendary Northwest Passage. For almost 30 years, since satellite measurements began, the Northwest Passage, which links the Atlantic and Pacific Oceans, was covered in ice all year round. According to data from the European Space Agency based on satellite images, the polar cap is shrinking rapidly and summer warming has melted the ice so much that the route can be declared navigable, a good example of the seriousness of global warming. The Arctic is one of the most inaccessible areas of the Earth, so we have no significant databases from before the advent of satellites. The opening of the route has already become a political issue, ahead of environmental issues. Canada wants to formalise full rights to the areas of the Northwest Passage that pass through the country, where it could also restrict transit traffic. The idea has not won the approval of either the European Union or the United States, which believe that the new route should be internationalised and open to all vessels, irrespective of their flags.

The opening of the Northwest Passage has raised a number of military issues that are waiting for a rapid resolution. Both the United States and Canada are now realising that their naval and air bases in the area have limited capacity to demonstrate a military presence.

To add to the problems caused by the disappearance of the polar ice cap, the country's defence budget has been cut. The Department of National Defence has summarised its capabilities in the North, which show that Canada has limited resources to deploy in the North. It has also become clear that changing this, launching a new military programme, will involve huge costs.

The cuts to the department's resources have resulted in the elimination of almost all programs that provided a presence for Canada in the North. The time spent flying over the North using long-range aircraft was steadily reduced and then eliminated. Victoria-class submarines lack the capability to operate in polar waters.

The Canadian Coast Guard has a key responsibility for monitoring the Arctic. The Coast Guard maintains an icebreaker fleet in the Arctic, consisting of two heavy icebreakers and three medium ice breaking vessels.

US military experts argue that the nearest military base, Thule, has minimal influence on the location and traffic of the passage due to its equipment and treaty status, and that the US presence is more symbolic, with its warships stationed at more distant bases. The Canadian navy wants to deepen the ports of the bases and deploy northern patrol vessels.[134]

The ongoing dialogue and the interest of both parties is demonstrated by the webinar on the current issues of Canada–US Arctic cooperation, organised by Global Affairs Canada (GAC) and the US Consulate General in Québec City on 10 May 2021.

During the online event, James DeHart, Arctic Coordinator at the US Department of State, Michael Sfraga, Director of the Polar Institute in Alaska, and Philippe Archambault, Scientific Director of the ArcticNet network of research institutes in Quebec, discussed the opportunities and priorities for bilateral cooperation.[135]

Director Sfraga highlighted seven themes that determine the views about the region:

- climate (the Arctic is warming three times faster than the global average, with rapidly changing environmental conditions; the Arctic Ocean is freezing more slowly, with direct impacts on both the near and distant environment)
- raw materials (oil, gas, rare earth metals and their well-considered and controlled extraction)
- trade (new transport routes, cross-border cooperation)
- connectivity (both physical, i.e. roads and railways, and "virtual" i.e. making broadband internet available)
- communities (involving indigenous peoples, building not just sustainable but thriving communities)

[134] Beeler 2017.
[135] Sands 2021.

– cooperation (Arctic Council, enforcement of the Law of the Sea)
– rivalry (the ambitions and interests of great powers)

According to the Director, both Canada and the United States need to develop and strengthen their bilateral cooperation in the region according to these concepts and categories.

Science Director Archambault spoke about collaboration on research and data sharing, with a focus on the environmental impact of increasingly intense maritime traffic. He said that the two countries have similar research priorities and interests here, and there are already many good examples of practical cooperation, notably through the exchange of researchers and equipment and the sharing of research results. The next step could be to launch joint government tenders in a specific research area.[136]

According to DeHart, Arctic issues are an important part of bilateral relations, as evidenced by the fact that the roadmap for the Trudeau–Biden meeting in February 2022 includes a commitment to further dialogue on the region. This will not only address security, but will take place in multi-dimensional manner, along the categories indicated by Sfraga.

The fundamental goal of the United States is to preserve the "enviable", conflict-free, peaceful character of the Arctic, while climate change is making the region increasingly "busy" and visited. Although this is a process that will take several years or decades, we must be prepared now to manage the changes (strengthening the coast guard, managing environmental disasters, etc.).

From a geopolitical point of view, DeHart identified two challenges, both significant: the traditional Russian *hard power* (renovation of old bases, deployment of new capabilities, military exercises in violation of the territorial sovereignty of others, etc.) and the more "sophisticated" (*soft power*) Chinese expansion (use of ports, gaining influence through infrastructure investments). He also described the North American Aerospace Defense Command (NORAD) as "critical" in this respect, and stressed that its modernisation is

[136] Sands 2021.

a priority. At the same time, he added that they are ready to cooperate with Russia and China in Arctic exploration.

US policy on the Arctic is also set out in the Biden Administration's *Interim National Security Strategic Guidance,* published in March 2021, in which DeHart highlighted strengthening international law, renewing alliances and the priority of rebuilding the homeland. Accordingly, priority will be given to the rule of law of the sea and the functioning of the Arctic Council (Blinken and Garneau will also attend the Council's ministerial meeting in Reykjavík on 19–20 May). As the Council does not deal with security issues, NATO and NATO allies will be relied upon in this area. It is also expected that the planned infrastructure investments in Alaska (ports, road upgrades) will have an impact beyond the immediate region.

On the strategic importance of rare earth elements, experts said that China is at a disadvantage in not being able to instruct companies to shape their investment policies, although it is trying to promote strategic, long-term investments in the Arctic region with the market-friendly tools available to it. Unfortunately, many obstacles (climate, infrastructure) persist. For Canada and the US, fisheries and renewable energy could still be areas of economic cooperation in the Arctic.

Although there is disagreement between the two countries on the legal status of the Northwest Passage (the US considers it to be completely open to access without permits, while Canada treats it as a sovereignty issue), in practice this disagreement is not an obstacle and coordination between the US and Canadian authorities works well.

Canada is seriously concerned about developments that involve changes in trade routes. Table 12 shows exactly why the two northern gateways are becoming increasingly important by shortening transport routes and making traditional passages irrelevant.

Military involvement in natural disaster defence is also a problem linked to climate change. Canada is facing an increasing number of natural disasters that require the involvement of the military. The military was involved in 12 cases between 1996 and 2006, 20 cases between 2007 and 2016 and 15 cases between 2017 and 2019 to prevent or recover from natural disasters. There are

Table 12. *Length of shipping routes on some routes (km)*

Route	*Through the Panama Canal*	*Through the North-west Passage*	*Through the North-east Passage*	*Through the Suez Canal*
Rotterdam–Shanghai	25,588	16,100	15,793	19,550
Bordeaux–Sanghai	24,980	16,100	16,750	19,030
Marseilles–Sanghai	26,038	19,160	19,718	16,460
Gioia Tauro (Italy) – Hong Kong	25,934	20,230	20,950	14,093
Barcelona – Hong Kong	25,044	18,950	20,090	14,693
New York – Shanghai	20,880	17,030	19,893	22,930
New York – Hong Kong	21,260	18,140	20,985	21,570
Rotterdam – Los Angeles	14,490	15,120	15,552	29,750
Lisboa – Los Angeles	14,165	14,940	16,150	27,225

Source: http://ports.com/sea-route

serious debates on how to maintain the combat readiness of the army and its ability to deploy in conventional operations under such stress. Two options have been put forward by experts: the first is to increase the use of reserve forces and the second is to create a military-technical force, the main task of which would be defence against disasters.[137]

In Canada, the tasks and priorities of the military are clearly defined. These include:

> "The Canadian Armed Forces are responsible for participating in disaster prevention and recovery at home and abroad, assisting government and non-government agencies.

[137] Chamandy 2021.

Table 13. *Canadian Air Force deployments abroad in humanitarian operations 2007–2017*

Location	*Year*	*Feature*
Jamaica	2007	wind storm (hurricane)
Burma	2008	wind storm (cyclone)
United States of America	2008	wind storm (hurricane)
Haiti	2010	earthquake
Philippines	2013	wind storm (typhoon)
Sierra Leone	2014	Ebola
Nepal	2015	earthquake
Caribbean	2017	wind storm (hurricane)

Source: Shadwick 2018: 76–83

> As natural disasters increase in number and intensity, the capabilities of the Canadian Armed Forces are increasingly needed. In addition to protecting against natural disasters, our soldiers can also play a role in supporting civilian organizations and protecting critical infrastructure and keeping it operational."[138]

In October 2021, General Wayne Eyre, then Acting Chief of Staff, said:

> "For many years, the CAF has been used as a force of last resort in disaster response, whereas today it is the force of first choice. This fact must be acknowledged at the strategic level."[139]

At the same time, Canada is also playing its part in defence in the international arena. The Canadian Air Force provided humanitarian assistance around the world on eight occasions between 2007 and 2017 (Table 13).

[138] National Defence 2017.
[139] Dumont et al. 2021.

AUSTRALIA

Australia cannot exempt itself from the national security implications of global climate change. In the *Defence White Paper,* released on 3 May 2012, the Australian Government made the following statement on climate change and resource security:

> "Global energy, food and water resources are under pressure from population growth, rising affluence and climate change. Robust demand for commodities is underpinned by rapidly emerging economies such as China and India. Demand for key commodities is expected to remain robust over the long-term.
>
> Resource insecurity is likely to grow in coming decades. Asia is expected to become 90 per cent dependent on imported oil by 2050, mostly from the Middle East. This increased demand for imported commodities is unlikely to lead to major interstate conflict as long as the global market operates freely, since it is cheaper to pay for a commodity than to go to war for it.
>
> The risks associated with resource insecurity may be exacerbated by changes in the global climate system. The inundation of low-lying regions, more frequent and severe natural disasters and shifts in rainfall patterns would lead to loss of agricultural production in some areas and potentially large-scale human migration. The combination of the effects of climate change and resource pressures will increase the risk of insecurity and conflict, particularly internal instability in fragile states, many of which have increasingly large populations in areas that will be affected by climate change. These factors, taken together, point to an increasing demand for humanitarian assistance, disaster relief and stabilisation operations over coming decades."[140]

In Australia, the Defence Force's priority task is to support the civilian population in the event of civil and natural disasters.[141] It also gives priority to

[140] See www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/rp1516/DefendAust/2013.

[141] In this respect, the army has had a busy year, with 150 weather records broken in 2013 alone, bringing heatwaves, wildfires, droughts and storms.

the security of the country's immediate environment (East Timor and the South Pacific), including participation in disaster response, whether caused by climate change or other natural forces. Australia remains ready to deploy its armed forces in international disaster response operations, as it did in Indonesia in 2004–2005 or in Japan in 2011. It is also worth noting that one of the defining areas of military cooperation and dialogue with China for more than 15 years has been the joint effort to combat disasters. This includes military exercises such as mutual visits by naval units, naval exercises and joint exercises in disaster relief. Australia is also developing its military forces and assets to enable them to participate effectively in disaster response.

However, there are also experts in the country who believe that further military efforts are needed. A recent report by the Australian Strategic Policy Institute (ASPI) says the military must increase its effectiveness in order to cope with the effects of climate change.[142]

The authors of the *Heavy Weather* study believe that the Department of Defence is not adequately addressing weather change in either a national or regional context, despite the instability it can cause through rising sea levels, increased immigration and the emergence of new infectious diseases.[143]

ASPI Deputy Chief Anthony Bergin claimed that the Australian Defence Force (ADF) is already doing a great deal to prevent and recover from natural disasters in the country, such as forest fires and floods, but it is increasingly expected to deal with emergencies in the region, often multiple disasters at the same time.

> "While we've been pretty good at dealing with offshore disasters without anything happening on the home front, I think we're now going to see the ADF really stretched in dealing with extreme weather events in the region and at home. Disease transmission, population displacement and subsequent resource wars could lead to the further weakening of fragile states and place greater demand on the ADF's involvement in regional stabilisation missions."[144]

[142] Press et al. 2013.
[143] Press et al. 2013.
[144] Brissenden 2013.

It must also not be ignored that some of the countries in its vicinity – Papua New Guinea and the Solomon Islands – can only rely on Australia. Papua New Guinea's Prime Minister James Marape attended the UN General Assembly in person for the first time this year, and took the opportunity to express the views of several Pacific island nations on climate change and sustainable development. His main message is that the island states in the region have a small ecological footprint, still are most affected by the negative consequences of climate change. Marape called for concrete action and assistance, rather than rhetoric, to provide real solutions to improve people's lives in the countries concerned, while combating deforestation, pollution and further rises in sea level.[145]

In Australia, the security threat posed by climate change is constantly on the agenda. Today, mainstream politicians agree that their country is highly vulnerable to climate change. Australia is geographically exposed to disruptions in supply chains. Fuel would only last for weeks, the efficiency of the military would rapidly decline, aviation would be threatened and agricultural productivity would plummet. As the ASPI report puts it, Australians are already at risk from climate change. One fifth of national GDP output is located and 3.9 million Australians live in areas at high risk of devastating tropical cyclones, 11% of GDP is located and 2.2 million people live in areas at very high risk of bushfires.

The report summarises the security risks posed by climate change. It states that climate change:[146]

– affects international security by endangering people's safety, increasing the likelihood of violent conflict resolution and multiplying the impact of other threats
– increases the intensity of competition for natural resources
– reduces the ability to support people, leading to significant migration flows
– reduces the security of food supply, which creates new tensions, especially in fragile states
– increases social tensions in all areas

[145] RNZ 2021.
[146] Australian Security Leaders Climate Group 2021: 35.

On several occasions, the country's army has participated in operations abroad to mitigate the consequences of disasters. A prominent operation was the support provided in Fiji, involving the air force, navy and ground forces. In 2021, technical teams from the latter spent several months on the island, helping to rehabilitate the educational infrastructure. Following the cyclone that devastated Vanuatu, air force planes delivered aid to the islands.[147]

RUSSIA

The regional military presence of the Arctic states has its roots in the Cold War era. The importance of the Arctic became clear in the 1950s, when Alexander P. de Seversky created his map focusing on the Arctic. The map shocked the public in the United States and made the importance of the northern defences clear. With the end of the Cold War, the development of the Northern military arsenal was devalued, and the states involved in the region modernised their militaries in other areas. One exception has been Russia, which ordered several new icebreaker vessels after the turn of the millennium, due to the relatively stable shipping traffic off its northwest coast.

In the Arctic Ocean, the presence of icebreakers and submarines is a key factor. Their importance is obvious, as they enable states to act as a sovereign power during the winter months, and they are also essential for the study of the continental shelf and for research expeditions. A military presence in the region is inevitable in order to patrol the northern waters, monitor fishing, carry out search and rescue missions and protect nature.

In terms of military potential in the North, Moscow has a clear advantage over other states. Of its three navies, the Northern Fleet is the most powerful and has the largest number of ships and submarines. In addition, the above-mentioned Northern Strategy issued by the Russian government

[147] Australian Government Department of Defence 2023.

has decided to create a special Arctic task force to protect Russian security interests and infrastructure in the northern border areas.

In addition to the Arctic countries (Russia, Canada, Finland, Sweden, Norway, Greenland, Denmark and the United States through Alaska), other countries that may claim economic and other activities in the Arctic include China, France, India, Japan, South Korea and the United Kingdom. This, and in particular China's growing presence, further complicates the already complex relationship between the Arctic countries. (Russia claims a significant part of the Arctic for itself, which is not accepted by the other Arctic countries.) Efforts to approach the Arctic are illustrated by Russia's plans to build 20 icebreakers in addition to its 55 existing ones, Canada's plans to build 9 in addition to 10, and the US's plans to build 3 more in addition to the 3 it already has. China would double the number of icebreakers it currently has, while France, Britain, Japan and India would build their first icebreaker.[148]

Moscow is also working with Helsinki on the development of icebreakers, with the undisguised aim of exporting technology or ships. Russia's primary goal may be to strengthen its military dominance in the region. News of Russian airspace violations, which appear several times a year, are closely linked to the ongoing air exercises. Air exercises in the Arctic Sea were re-launched as a consequence of a decision by Vladimir Putin in August 2007. Russia also keeps in mind modernising its Northern Fleet, which has been the subject of several reports in recent months, with Northern nuclear and spy submarines currently under refit (the Northern Fleet's main port is Severomorsk, and its areas of operation are the Arctic and Mediterranean Seas and the Atlantic). In the meantime, the refurbishment of the only Russian aircraft carrier in the fleet, the Admiral Kuznetsov, built in 1985, has also been considered, and work started in 2012. However, steeply rising costs and construction problems make it impossible to estimate the completion date. Nevertheless, during his visit to Sevastopol in 2020, the President said:

[148] National Intelligence Council 2021.

> "The Navy was always and will always be the most important component in national defence and security, [and] in the 21st century we have to preserve and strengthen the status of our country as one of the leading naval powers. By 2020, more than 70% of all naval armaments and equipment will be based on new, modern technology."[149]

The latest news also confirms Russia's vested interests in the northern region. Vladimir Putin spoke on the international legal issues regarding the delimitation of Russia's Arctic Sea borders at a meeting of the National Security Council on 22 April 2014. He stated that Russian experts and diplomats in the negotiations "must stand up for each and every part of the Russian continental shelf and maritime territory".

The Russian President also stressed that Russia is interested in the sustainable development of the region "on the basis of cooperation and unconditional respect for international law".[150]

The Arctic remains a special sphere of interest for Russia, the Head of State said. Russia has more than 1,600 billion tonnes of hydrocarbon reserves in the region, he said. This is a quarter of the world's energy reserves under continental shelves.

According to Putin, the rapid pace of foreign policy and socio-economic changes in the world "pose new risks and challenges for Russian national interests", including in the Arctic. He explained that oil extraction facilities and pipelines need to be protected from terrorism and other potential threats, and the Federal Security Service's border security team must be strengthened to protect Russia's Arctic borders.[151]

Nikolai Patrushev, Secretary of the National Security Council, said after the meeting that so-called unified ship and submarine bases will be established in the Arctic, which will not only serve the purposes of the Ministry of Defence, but also of other authorities and ministries. Airports and military

[149] Staalesen 2020.
[150] Népszava 2014.
[151] Népszava 2014.

bases that were still in operation during the Soviet Union but have since been abandoned will be renovated to ensure the security of the North Sea route.[152]

The seriousness of Russia's ambitions is demonstrated by the launch of the Arktika universal nuclear-powered icebreaker at the Murmansk port in 2020. Currently the world's largest nuclear icebreaker, it is capable of independently guiding even large cargo ships through the icy seas of the Arctic.

Rosatomflot, part of the Russian State Atomic Energy Corporation, operates the world's only fleet of nuclear icebreakers, which currently consists of six nuclear icebreakers, a nuclear-powered container icebreaker and support vessels.

Meanwhile, at Russia's newest shipyard, Zvezda in the seaside border town of Bolshoi Kamenny, construction has begun on a new type of nuclear icebreaker, Leader, which is expected to enter service in 2027. Russia's known strategic goal is to build a fleet of modern nuclear-powered icebreakers that will ensure regular, year-round safe navigation on the North Sea route. The deployment of the nuclear icebreakers will enable continuous shipping in the Eastern Arctic and the creation of new trade routes in the North Sea to the North.

The shortest route between the western and eastern hemispheres of the northern hemisphere is through the Arctic Circle. Nevertheless, for now, it is covered by a thick layer of ice. Climate change opens up new horizons. Melting ice could shorten shipping times between Asia and western ports by up to 20 days. It is no coincidence that the Arctic shipping routes that will be ice-free are being called the new Suez and Panama Canal of the 21st century. The geopolitical importance of the Arctic has also increased because it contains 13% of the world's oil, 30% of its natural gas and 20% of its liquefiable natural gas. Russia is in the best position to compete for the Arctic, as most of the potential North Sea shipping routes would pass off its shores. This advantage could be further enhanced by icebreakers.

Moscow considers the North Sea route to be of strategic importance, and efforts have not been slowed by the coronavirus epidemic and the global economic

[152] Népszava 2014.

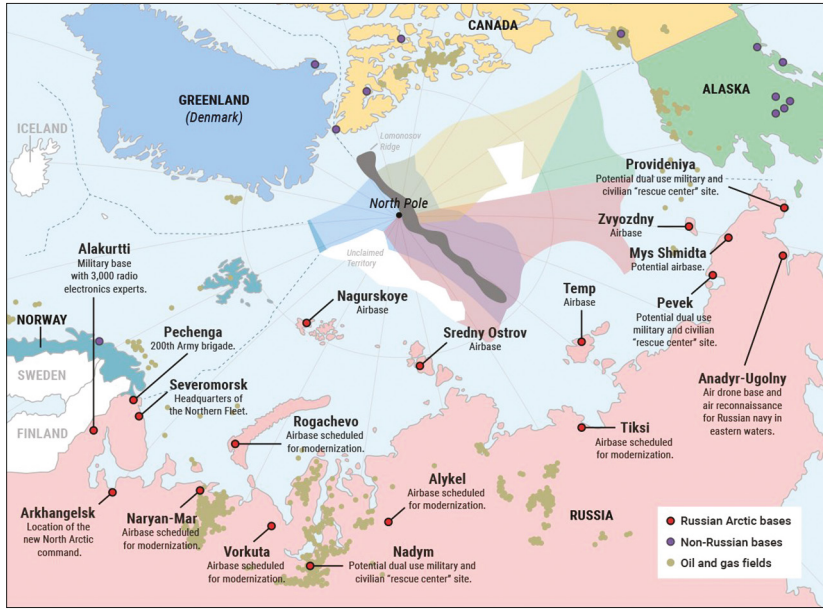

Figure 12. *Location of military bases in the Arctic*
Source: Bender 2015

downturn. In the first eight months of 2020, 20.47 million tonnes of goods were transported along this route, up 3.3% year-on-year. In this period, a total of 782 shipping authorisations were issued for this route, 16% more than in the previous year. Of these, the number of foreign flagged carriers increased by 53% to 123.

The northern shipping route bypassing Suez, initially considered by many to be unfeasible, is therefore developing much faster than expected in the West. This contradicts those competitors that not only considered the Russian efforts to be pointless, but also deliberately discredited the northern route on the grounds of economic rationality and shipping safety. The number of foreign flagged ships that have recently appeared in this area belies these assumptions, and the proliferation of nuclear icebreakers further reduces transit times and increases safety.

This is strongly resented by the United States, which also claims opportunities in the Arctic. In response to Russian successes, two air bases will be established in Alaska, considered a bridgehead for the Arctic and Russia, where 150 F–22 Raptor and F–35 Lightning fighter-bombers will be deployed. The deployment of strike fighters is part of a strategy to prepare for the growing competition for the Arctic, including military operations in the region. Russia and China are seen as the number one challenge in this regard by US strategists. This will of course prompt Moscow to respond, and it has already begun to deploy air bases along the North Sea shipping lane to ensure smooth passage in military terms (Figure 12). It is also expected to redeploy forces to Kamchatka in response to the arrival of US aircraft in Alaska.[153]

GERMANY

In June 2019, German Foreign Minister Heiko Maas said that responding to the impacts of climate change is the country's "new foreign policy imperative", as the security implications of these impacts are already visible worldwide. Germany wants to play a leading role in the fight against the threats to peace and security posed by climate change. The German Government, as a member of the UNSC, has made climate change mitigation the focus of its two-year mandate and is working to make this effort an important part of UN policy.[154]

German Defence Minister Annegret Kramp-Karrenbauer said that one of the biggest challenges facing the country's armed forces is to increase their ability to adapt to the challenges posed by climate change. At the same time – or perhaps because of this – the development of equipment cannot be delayed and must also be reflected in strategic planning. In the view of the Minister of Defence, the consequences of climate change are already in the short term "a central challenge for global stability and security" and therefore deserve the special attention of the German military. An analysis of

[153] Stier 2020.
[154] Wettengel 2019.

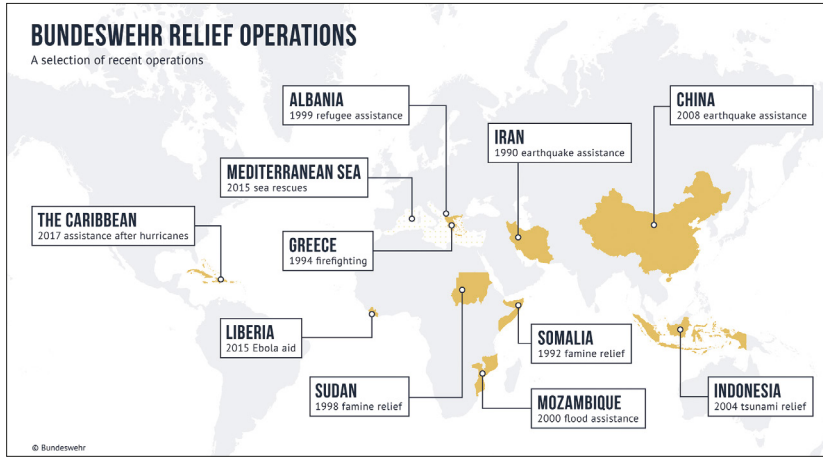

Figure 13. *Bundeswehr humanitarian missions 1992–2017*
Source: Bundeswehr [s. a.]

the challenges facing the German Army (Bundeswehr) has also highlighted this issue: the most important factors influencing the security environment today are the changing international security landscape, the ambitions of emerging powers, technological developments, demographic changes, epidemics and the consequences of climate change.[155]

One reason for this is the significant increase in military assistance, both domestic and foreign, related to climate change. This has been the case in the drought-hit Sahel region in North Africa, or on home soil in the fight against forest fires (Figure 13). Soldiers are also involved in defence on home soil.

Following the floods in the west and southwest of Germany on 15 July 2021, the Bundeswehr deployed 1,450 soldiers to assist in the affected areas.

"We need to rethink the Bundeswehr's organisational structure to make it more resilient and able to respond quickly and effectively to the consequences of climate change," the minister said. This includes modernising logistics and

[155] Federal Ministry of Defence 2021.

equipment, improving the effectiveness of response capabilities and training. This is in addition to the fact that the German army has already started to use green technology for soldiers.[156]

According to the German Ministry of Defence, the Bundeswehr has achieved significant reductions in emissions in recent years. The army's total carbon dioxide emissions fell by 20% from 1.78 million tonnes in 2015 to 1.45 million tonnes in 2019, despite its expanding tasks. It is also recorded that the military has achieved an even greater reduction of more than 46% since 2005, particularly in transport emissions. As such, the Bundeswehr has been much more successful in "green mobility" than the country as a whole.[157]

HUNGARY

The National Security Strategy adopted in 2012 states the following in the chapter on *Security threats and challenges for Hungary and their management:*

> "The global climate and environmental change, the impacts of extreme weather, the depletion of raw materials and natural resources, the problems of access to clean potable water, as well as the worsening food supply problems all entail serious global security risks and may become sources of conflict. The environmental, civilisational and health-related sources of danger, arising either globally, in the region or Hungary, may pose a threat not only to the security and development of the country, but to that of the region as well. Furthermore, due to its geographical characteristics, Hungary is particularly exposed to the effects of environmental and civilisation hazards emanating from the countries bordering the Carpathian Basin, to floods and water and air pollution. The environmental sources of danger also have an indirect effect on the health of the population.

[156] The German armed forces are phasing out the use of coal for heating purposes. The last coal-fired heating system in barracks will be replaced by a biogas supplemented system for the peak winter season. The new system will have a capacity of 5 megawatts and will save around 3,000 tonnes of CO_2 per year (Amelang 2019).

[157] Wehrmann 2020.

> The preservation of natural resources and values, increasing the security of flood and inland water protection, the elimination of health risks and epidemics, the maintenance of food and water security, the elimination of pollution found in the soil and in the sub-surface waters as well as the recovery of environmental damage and managing the associated risks all constitute security policy considerations for Hungary.
> The protection of water supplies and farmland, securing the conditions for supplying the population with clean potable water and with non-GMO food, as well as the continuous provision of services and ensuring preventive public healthcare against epidemics are indispensable for the creation of environmental security."

In the chapter on the *Ways and means of implementing the National Security Strategy,* the following is mentioned in relation to the use of military force:

> "The Hungarian Defence Forces are the primary institution to guarantee Hungary's sovereignty and one of the main means of implementing Hungarian foreign policy in the context of international engagement. The fundamental task of the Hungarian Defence Forces – in compliance with the Basic Law – is to guarantee the security of our country and to contribute to the collective defence of Hungary's Allies. In order to be able to carry out their domestic and international tasks, the Hungarian Defence Forces need well-equipped and trained forces as well as flexible, usable, deployable and sustainable capabilities to defend the sovereignty and territory of the country, to contribute to collective defence within the NATO framework and to UN, NATO, EU or OSCE-led international peacekeeping, stabilisation or humanitarian operations. The Hungarian Defence Forces also need to possess capabilities to actively contribute to disaster relief in case of natural or industrial catastrophes. Defence planning and doctrines of the Hungarian Defence Forces need to be based on tasks set out in the Basic Law, as well as international commitments, and be developed in coordination with Allies. Providing the resources required and their purposeful and effective use is essential. Multinational cooperation including the development and sharing defence capabilities through international cooperation may serve as a flexible and economically efficient tool to this end. In developing its defence capabilities, Hungary must increasingly rely on domestic, NATO as well as EU programmes, thus facilitating the development of the national defence and security industry.

> A comprehensive definition of security means that the tasks flowing from the implementation of the National Security Strategy concern numerous governmental and non-governmental organisations. A whole of government approach requires all governmental tasks to be fulfilled through the coordinated work of state structures and by making the fullest possible use of the comprehensive set of means available. Security related activities of the different state institutions must comply with the National Security Strategy, and the periodic review of the sectorial strategies will be guided by the relevant provisions of the National Security Strategy."[158]

Comparing successive National Security Strategies (eight years passed between them) a few things immediately stand out:

- In 2012, climate change was already being called by its name, and there is a very strong view on the threats it poses.
- In relation to the use of military force, the focus in our research area remains on disaster response.
- There is a constant requirement for a comprehensive, sectoral division of tasks that applies to all stakeholders; in other words, each must enforce the provisions in their own area.

The latest National Security Strategy 2020 also puts this issue on the agenda:

> "These new challenges stem from an emerging multi-polar world order; efforts to restructure the rules guiding relations between international actors; the changing nature of security challenges; global challenges such as the acceleration of climate and demographic changes with which illegal and mass migration and the depletion of natural resources are closely associated; and finally, the transformative effects of the technological revolution on society."[159]

Sectoral strategies also address this threat. The previous National Military Strategy already broke down the requirements for the sector in 2012. It sets out the following:[160]

[158] Ministry of Foreign Affairs of Hungary 2012.
[159] Government Resolution 1163/2020 (IV. 21.) on Hungary's National Security Strategy.
[160] Ministry of Defence 2012.

– The importance of non-military aspects of security is constantly increasing, however, that does not go together with a decrease of the role of military factors.
– The Hungarian Defence Forces contribute to countering natural and industrial disasters, mitigating their consequences, managing humanitarian crises and, if necessary, participating in the support of civilian authorities.
– It is able to participate in the response to natural and industrial disasters and their consequences by maintaining and developing disaster management skills.

The National Military Strategy published in 2021 also addresses this issue in several places. On the one hand, it identifies illegal migration as a root cause, and on the other hand, it talks about it as a possible cause of the number and intensity of natural and civilisational disasters.[161]

From the above lines, clear challenges can be derived for the use of military force in our research area.

In the Hungarian Defence Forces, the introduction of improvements that prioritise environmental protection, and thus help adaptation, started years ago. One of the areas of this is the environmental improvement of military facilities, thereby reducing emissions through the widespread use of renewable energies and rationalising energy use. The main elements of the programme, which will be implemented with EU and national funding, are as follows:[162]

– Within the framework of the *Environment and Energy Operational Programme* (KEOP) of the New Széchenyi Plan, the Ministry for National Development is preparing the construction of solar hot water production in the army facilities in the country, and energy-saving improvements in military buildings and the replacement of coal-fired and gas-fired boilers, and the modernisation of boilers.
– Within the framework of the *Széchenyi 2020 Operational Programme for Environment and Energy Efficiency* (KEHOP), the Ministry of National

[161] Government Resolution 1393/2021 (VI. 24.) on the National Military Strategy of Hungary.
[162] HM Védelemgazdasági Hivatal. Online: https://hm.vedelemgazdasagihivatal.kormany.hu.

> Development has funded the "[...] building energy efficiency development of the Hungarian Defence Forces Medical Centre". Substitution of part of the electricity consumption of buildings managed by the army with renewable energy sources, installation of small photovoltaic power plants.

One of the tangible results of these programmes is the nearly 900 million EUR upgrade of the HDF Medical Centre in 2017. As part of the building energy investment, windows and doors were replaced with modern structures, external boundary walls and ceilings were retrofitted with thermal insulation, and household-scale solar energy systems were installed at two sites.[163]

The energy efficiency upgrade of a hostel for women, managed by the HDF, was also completed in September 2022. Based on the positive decision of the Ministry of Innovation and Technology, the project was implemented with a gross amount of 157.22 million HUF, using non-refundable European Union funding. As a result of the development, the building on the Kassák Lajos Street site was insulated on the façade and roof, the windows were replaced and a household-scale photovoltaic system was installed.[164]

Also related to adaptation and flooding, which is becoming more frequent due to climate change, is the project entitled *Improving the Disaster Response Capability of the Hungarian Defence Forces,* which was implemented with the support of KEHOP-1.6.0-15-2016-00003. The aim of the project is to contribute to the development of a higher quality of disaster management activities in order to increase the safety of persons and the property of the population.

The project cost exceeded 2 billion HUF, mainly in order to upgrade equipment to help protect against flooding, and lasted until the end of December 2017.

With the development, the Hungarian Defence Forces have expanded its capabilities used in disaster management interventions, thus contributing to the effectiveness of the national disaster management system. The modernisation of the command and control system and the info-communication of

[163] Honvedelem.hu 2017.
[164] Honvedelem.hu 2022.

the intervention teams have improved the management of the intervention forces and the cooperation with the partner services.

The project included, among other items, personal protective equipment for flood protection, high-powered pumps, camp lighting, rubber boats and boat engines. In addition, amphibious transport vehicles used for flood protection, but also used to rescue the population, have been refurbished, and the capacity to supply food and healthy drinking water has been increased. In addition, the refurbishment and rebuilding of technical equipment and an increase in tenting capacity have been carried out.

In total, 25 intervention teams of the Hungarian Defence Forces are involved in this development. Of these, 18 have had their capacity increased and seven new teams have been created.[165]

It is also worth pointing out that organisational improvements are also ongoing in this area. In an interview, the commander of the Hungarian Defence Forces said:

> "The areas affected by extreme drought continue to grow, with water scarcity and fires emerging due to the heatwave and drought conditions not seen for fifty years. For this reason, the Hungarian Defence Forces has stepped up their preparedness services to help the disaster management authorities, either by supplying water or by fighting fires. Two weeks ago, Hungarian soldiers were involved in fighting forest fires in Slovenia. We can make all the capabilities of the Hungarian Defence Forces available both at home and abroad [...] the HDF standby forces almost cover the country, which means they can support the disaster management staff everywhere."[166]

In Hungary, researchers in military science and military engineering disciplines have been working on the effects of climate change, adaptation issues and challenges for the armed forces for many years.[167] It is not surprising,

[165] Honvedelem.hu 2016.

[166] Antal 2022.

[167] A few of the publications on this subject: Végvári–Király 2017: 54–73; Hankó–Földi 2008: 20–26; Berek 2015: 61–73.

therefore, that the developments of the *Zrínyi Defence and Force Development Programme* also seek to increase the effectiveness of adaptation. Although the elements of the programme are not public, the information already available indicates that climate change related attitude is present. To demonstrate this, here are some of the initiatives that are taking place as part of the programme, in cooperation with the HDF Institute for Modernisation:

– Hungary, along with Slovenia, Austria, Belgium, Germany participates in a project to improve energy efficiency in the defence sector, also supported by the European Defence Agency. The aim is to develop hydrogen-based refuelling points at five military sites in Hungary to supply allied military convoys passing through the country.[168] The Slovenian-led initiative, called the *Defence RESilience Hub Network in Europe* (RESHUB), is being funded by the EU to promote the uptake of renewable energy and build hydrogen energy storage capacity, reducing carbon emissions in the defence sector.[169]
– A multi-year project to replace obsolete aggregator equipment has also started, with the aim of developing a hybrid field power complex that will utilise the potential of hydrogen-based energy storage.
– In international cooperation with the Swiss Federal Office of Defence Investment, the Institute of Materials and Environmental Chemistry of the Natural Science Research Centre and the Swiss Federal Institute of Technology, a series of tests is carried out to compare the combat applications of battery and hydrogen energy storage technology. This will involve testing both the electrical parameters and the behaviour of these energy storage devices when damaged by gunfire or shrapnel.[170]

We must also mention the initiative of the National Research, Development and Innovation Office. Within the previously successfully announced *Thematic Programme of Excellence* (TPE), the *National Defence and National Security* (NNA) sub-programme was launched in 2021 with a budget of

[168] Végvári 2021: 20–25.
[169] Defense Aerospace 2020.
[170] Végvári 2021: 20–25.

25 billion HUF. One of its main objectives is to generate basic research results that will contribute to the development of responses to challenges to civilisation or lay the foundations for applied research and experimental development based on these, and to trigger further development and innovation processes within the institution. Flagship research topics (among others) are:

– energy security, renewable energy, smart energy storage and regulation; hydrogen energy storage and alternative propulsion
– research to improve disaster management procedures and technologies
– research to protect critical infrastructure for national security[171]

National Climate Change Strategy

The National Strategy on Climate Change is a highly cross-sectoral and cross-societal framework, covering all sectors and social groups. Based on the principle of integration, this means that environmental protection is an integral part of all sectoral policies. Accordingly, the aspects and guidelines of the climate change strategy need to be integrated into all national government strategies with activities that are directly or indirectly related to climate change. The elements of the strategy are therefore also relevant to the defence sector and need to be taken into account. Furthermore, it should not be overlooked that the Hungarian Defence Forces is still a major player in shaping the environment, partly because of the number and quality of its personnel, facilities and technical equipment, and partly because of the specific nature of its activities.

Options for emission reductions

The *National Strategy on Climate Change 2008–2025* (NES1) states that the state must promote and encourage the increase of energy efficiency and the spread and

[171] Tématerületi Kiválósági Program 2021. Online: https://nkfih.gov.hu/tkp2021.

use of renewable energy sources (wind, solar, geothermal, biomass, etc.), so the use of renewable energy to replace fossil fuels needs to be increased from 55 PJ in 2006 to 186.4 PJ in 2020.[172] During the revision of the NES1 review, it was declared that:

> "Climate change awareness-raising activities have to be strengthened. This is the third pillar of the intervention options, alongside prevention of adverse effects of climate change and strengthening resilience to adverse effects. [...] In order to achieve the objectives of reducing emissions, enhancing absorption and adapting to climate change, the conclusions, tasks and objectives set out in subsections 2.2 to 2.4 must be integrated into sectoral and territorial policy planning processes and mainstreamed into related decision-making."[173]

In the practice of the Hungarian Defence Forces, this means that energy-saving investments are to be made to reduce the energy consumption of the sites. This can be insulating buildings, using renewable energy sources, energy-saving consumers and the gradual conversion of the vehicle fleet.

Tasks of adaptation

The Hungarian Defence Forces is involved in adaptation from several aspects. Our soldiers are at increased risk from a health point of view, as part of their duties are carried out in the field, meaning that they are directly affected by the hazards posed by warming. This is true for temperature, as our soldiers are already exposed to increased load during training. It is also true for public health issues, as they are also directly exposed to this threat in the field.

It is essential that the education, training and preparation of soldiers include more awareness-raising, and that climate change is everyone's business. At the Ludovika – University of Public Service in Budapest, the challenges of climate change are currently part of the education curriculum, but they do not receive

[172] National Assembly Resolution 29/2008 (III. 20.) on the National Strategy on Climate Change.
[173] National Assembly Resolution 23/2018 (X. 31.) on the second National Climate Change Strategy 2018–2030 with an outlook for 2050.

the attention they deserve. In our view, there is a place for research on this issue not only in those courses and disciplines where it is a key issue in the profile of the subject,[174] but in all courses and disciplines where the use of military force and security are key issues.[175] In addition to bachelor's and master's degrees, doctoral studies are an area where research on climate change issues would be really important. At the time of data collection, there were 342 research topics announced in the Doctoral Schools of Military Science and Military Engineering, but only six addressed the effects of climate change directly.

The effects of projected climate change are expected to include increased floods and excess waterways, and more frequent droughts. The last few years have shown that we also must increasingly take into account the risk of flooding from small watercourses. When we talk about adaptation, we cannot avoid the fact that the Hungarian Defence Forces is one of the key contributors to flood protection.[176] Based on centuries of experience, we can say that the use of military force in flood defence is unavoidable. The likely increase in rainfall in the context of climate change, as confirmed by recent years, will also increase the use of military force. It is therefore worth reviewing the capabilities and limitations of the Hungarian Defence Forces in this area.

A number of assets and specialists of the Hungarian Defence Forces are involved in this work, grouped into various categories. The content of the groupings is as follows:

– Divers (to carry out specialised tasks that have to be performed underwater or in the water; typically, inspecting embankments, locating dam breaks, removing structures from the water, laying protective covering).
– Lifting machinery (mechanical loading), earth-moving machinery (moving heavy loads of soil, road construction and repair).

[174] Defence administration.

[175] Military leadership, security and defence policy.

[176] During the 2006 flood defences, 10,695 soldiers were deployed between 30 March and 9 May. There was a day (21 April) when 3,622 people and 643 technical devices were working simultaneously to reinforce the embankments. In 2013, this number exceeded 9,000, including thousands of volunteer reservists (Tokovicz et al. 2012: 63).

- Medical (on-site medical care for rescued persons and members of the rescue team, specialist medical care).
- Power supply and lighting equipment (to illuminate the work area of the rescue forces, to provide electricity in the field).
- Waterborne means of transport (transport of forces, equipment, salvaged goods on water, rescue from hard-to-reach places).
- Air transport (reconnaissance, patient transport, rescue, transport of materials to hard-to-reach places by helicopter).
- Blasting specialists (opening embankments, blasting ice, blasting dams).
- Supporting forces (transport, area closures, equipment and maintenance of military camps, manual labour).
- Water purification equipment (to provide drinking water to rescue workers and evacuees).

The list shows the wide range of forces and means available for flood protection. The advantages of using military force include:

- It avails of specialised equipment and specialists with specific skills that are not available in other organisations.
- It has its own logistical support, is able to fully supply the forces and assets deployed and does not need additional support. This also means that it is capable of carrying out complete tasks or managing defence phases.
- Its connectivity and information system is mobile, quick to deploy and highly resilient.
- Its mobility, standby system and organisation of shifts are very efficient.

These characteristics, combined with centuries of experience in flood defence, mean that the use of military force will remain indispensable in flood situations caused by climate change.

It is also worth mentioning here that the temporary military organisation known as the Tisza Battalion is an example of international cooperation. The task of the technical battalion, created by four nations (Hungarian, Slovak,

Romanian and Ukrainian) is to be able to intervene quickly in any of the four countries in the event of a flood threat in the Tisza Valley.

Without going into the military means of defence in detail, we must mention the world-class water purification equipment that has repeatedly proved its effectiveness. The device is capable of producing drinking water from fresh water, brackish water, seawater and water contaminated by chemical, radiological or biological agents.[177] The resulting drinking water can be used for drinking, cooking, food preparation or other domestic purposes. The amount of input raw water does not depend on the level of contamination, with 13.5 m^3 of raw water required for optimal use of the ultrafiltration unit. The quality of the drinking water produced meets the requirements of Hungarian and federal standards.[178] One of the characteristics of the water treatment technology used is the minimal use of chemicals, thus low environmental impact. The storage and packaging of the extracted drinking water is facilitated by an automatic packaging machine to hose bags at each water treatment plant. The machine is capable of packaging 18,000 litres of water per day in plastic bags. It does not take much imagination to see the usefulness of this device during a large-scale flood.

We also need to talk about the contribution of the Hungarian Defence Forces in helping areas with arsenic-affected water. From the beginning of 2013, the Hungarian Armed Forces will supply drinking water to settlements where the arsenic content of the water exceeds the limit set by the European Union. The *Water Source 2013* task has been and is being carried out by the armed forces under the leadership of the Armed Forces Joint Command (MH ÖHP), through the subordinate military organisations.

The *Water Source 2013* operation itself is very large in scale: the MH ÖHP started providing healthy water to 123 municipalities, supplying about

[177] Types of raw water that can be used: biologically active waters of natural origin; surface waters, boreholes, industrial water systems containing natural contaminants; saline waters containing natural contaminants; seawater; other waters containing dissolved salts; chemical, radiological or biological contaminated waters.

[178] Government Decree 201/2001 (X. 25.); MSZ 450-1/1989, MSZ 450-2/1991; MSZ 450-3/1990; STANAG 2136; STANAG 2885.

290,000 people. After 1 January 2013, the number of municipalities covered increased steadily, based on the requests sent by the Ministry of the Interior. At any one time, a maximum of 162 municipalities, about 420,000 people and 75 public institutions were supplied with healthy drinking water by soldiers from 11 base barracks. A total of 723 soldiers and 166 different technical devices (plus 42 reserves) were involved in the task.

The figures are most impressive: since 1 January 2013, soldiers have distributed more than 4.5 million litres of bagged water and nearly 13.7 million litres of running water. Daily delivery has varied flexibly according to demand and location. In the meantime, technical equipment has travelled more than 2 million kilometres. As of 1 January 2014, 83 municipalities, 45 public institutions and 192,379 people are to be supplied by the participating military organisations.[179]

Several conclusions may be drawn from the reflections presented so far:

– The changes threaten the stability of our country and its environment, so security concerns inevitably arise.
– The military, as well as being the agent of change, suffers the consequences in the same way as other sectors of society.
– As expeditionary operations come to the forefront, our troops may also find themselves in climates where the consequences of climate change are more pronounced.
– The Hungarian Defence Forces is able to intervene effectively in the prevention of disasters caused by climate change and the elimination of their consequences thanks to their specialised technical equipment and their specialised training.

POTABLE WATER AS A STRATEGIC FACTOR

In 2012, the US intelligence community conducted a study on access to fresh water. Their report painted a bleak prospect, making it clear that scarcity of fresh water could even lead to armed conflict. They pointed out that many

[179] Draveczki-Ury 2014.

countries that are important to the United States will face water scarcity in the next decade. Increasing water scarcity, poor water quality and frequent, devastating floods will weaken these countries and increase the likelihood of regional tensions. Demand for fresh water far exceeds available supply, exacerbated by waste and growing population demands. This is causing problems in the food and energy supply of these countries, affecting the functioning of global supply chains. North Africa, the Middle East and South Asia are facing serious challenges due to demographic explosion and the demands of economic development, with persistent water scarcity in these areas.[180]

The report also mentions that water scarcity, access to water can be a weapon, a potential for blackmail in the hands of countries that control the specific water source. Furthermore, it is not excluded that extremist groups will not shy away from exploiting the vulnerability of water resources to achieve their goals. Protecting them and promoting more efficient ways of using water, in industry and agriculture, is therefore a priority. The report also looks specifically at the environment and the situation of some strategic rivers (Annex III). It is clear from the Annex that the problems identified in the river basins studied are generalisable at global level. The lack of proper cooperation between the countries along the rivers concerned, the absence of agreements and concerted action, and the conflicting interests of upstream and downstream countries make it difficult to find solutions. All this is exacerbated by variable water yields, droughts and floods, water pollution and the role of dams. As such, it is no wonder that food security in these countries is being undermined, that the state is being weakened by a series of internal and external conflicts, that there is a massive exodus due to decreasing 'carrying capacity', and that this is creating more and more new tensions.

"The planet has never been so thirsty," says the UN *World Water Development Report 2015,* released in New Delhi to mark World Water Day.[181] Researchers say that while there is enough drinking water to feed the world's

[180] US Office of the Director of National Intelligence 2012.
[181] UNESCO 2015.

population, it will require fundamental changes in agriculture and serious steps to keep water clean.

According to the report, unless serious reforms are made towards sustainable water management, in most regions of the world we have already passed the point where the natural cycle can replace freshwater used or polluted by humans. While our planet is rich in water resources, since 76% of the Earth's surface is covered by water, only 4% of this is freshwater, and more than 70% of this is in the polar caps.

The most serious problem is population growth: the current population of 7.3 billion is projected to rise to 9.6 billion by 2050, with population growth exploding in regions where potable water is already an issue. These are the desert areas of Africa, the Middle East, and the metropolitan areas of South and Latin America, including Mexico City, São Paulo and Rio de Janeiro. In some parts of the two Brazilian cities, consumption is already being restricted to avoid a total collapse of the system,[182] and the remaining drinking water supplies are threatened by industrial pollution and contamination from agricultural fertilisers.

Meanwhile, the waste is staggering: the annual per capita water consumption of US citizens is over 2,700 m^3, while in Bangladesh it is less than 800 m^3 (in Hungary it is 1,385 m^3, corresponding to 9,000 filled-up bathtubs). The biggest consumers are industry and agriculture, which account for 70% of total water use. In the western states of the United States, Nevada (Las Vegas) and California (Los Angeles), no serious action has been taken despite the fact that water supplies have been declining for 20 years and serious supply problems will emerge in the coming years. Nevertheless, potable water is still used for washing cars and irrigation. According to the UN report, the most important step would be to increase water charges drastically to curb wastage by wealthier households, industry and agriculture.[183]

When we look at the impact of the scarcity of potable water on security, we discover striking findings. It is generally agreed that:

[182] Klímablog 2015.
[183] UNESCO 2015.

- A reduction in the quality and quantity of water supply can be a trigger for riots and emerging violence.
- Access to water can be a key reason and objective for negotiations between nation states.
- Changes in shared water resources inevitably increase tensions between the states concerned, and could even be a cause of armed conflict.
- Water scarcity can also be exploited by non-state actors such as violent and extremist organisations, insurgents and other belligerents.
- Scarce access to water can amplify secondary effects that lead to an armed conflict.
- Water scarcity and access becomes a weapon in the hands of belligerents, it became a strategic asset and it also becomes a pressure factor in diplomatic negotiations.
- Access to fresh water or lack of it, or restricted access to fresh water, is likely to increase tensions between neighbours living in the catchment areas of shared rivers, and make finding mutually acceptable diplomatic solutions more challenging.

In the fight for drinking water, military force is a key factor, so it is worth illustrating the potential of armed forces with a few examples.

Water as a weapon in Crimea[184]

Russia annexed Crimea on 18 March 2014. Following the independence referendum, an agreement was signed in the Kremlin on 18 March 2014, on the Republic of Crimea and Sevastopol, which has special status on the peninsula, joining Russia.

The problem of supplying water to Crimea, which is short of natural freshwater sources, arose immediately after the annexation of the peninsula.

[184] Padányi 2015: 272–284.

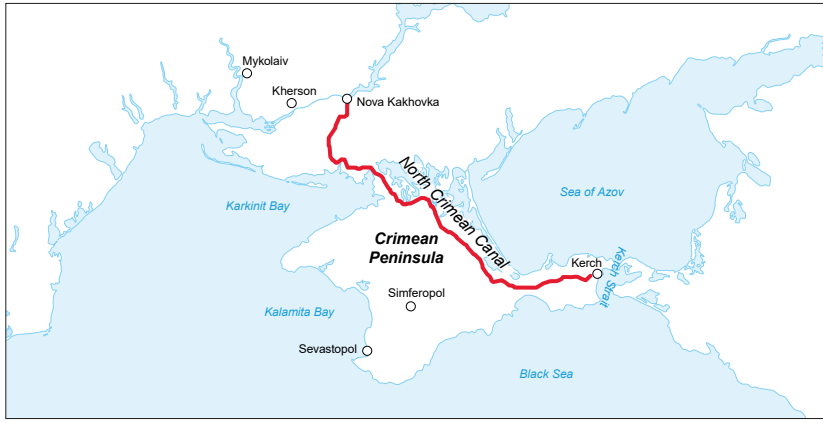

Figure 14. *The North Crimean Canal*
Source: Wikipedia 2023b

Russian Prime Minister Dmitry Medvedev recently acknowledged that this is one of the most serious problems for the annexed peninsula, as its water supply depends on an "external source", the North Crimean Canal (Figure 14). Another problem is that the water supply system is very outdated, and about half of the drinking water goes to waste.

The water supply of Crimea (27,000 km^2 and 2 million people) is provided by local surface water resources (910 million m^3 in normal weather) and the North Crimean Canal. The latter was cut off by Ukraine on 26 April 2014. The canal connects the main branch of the Dnieper River with Crimea and provides 85% of the freshwater supply to the peninsula. The 402.6-kilometre-long Northern Crimea Canal was built between 1961 and 1971, starting at the Kakhovka reservoir and ending at the town of Kerch on the eastern tip of the peninsula. The canal is capable of transporting 300 m^3 of water per second. This is supposed to supply drinking water to the peninsula's population, but also ensures the irrigation of some 250,000 hectares of agricultural land every day.[185]

[185] Vynogradova 2020.

Local farmers are trying to respond to the problem by drilling wells and laying pipelines from the more water-rich areas of the peninsula to the poorer ones. Farmers used to irrigate from canals from the Dnieper River, but Ukraine has reduced the amount of water coming into Crimea, so that significantly less water is reaching the peninsula than before (but farmers have already planted less water-intensive crops this year, thinking ahead and acting preventively).

Medvedev promised that the government would look into all options to address the problem. He suggested laying a pipeline from Kuban, east of the peninsula, across the Kerch Strait, or building a reservoir on the Taman peninsula, also across the Kerch Strait. According to Medvedev, drilling wells or desalinating seawater could also be a way to solve the problem of water supply in Crimea.

However, academician Vladimir Kashin, head of the Russian State Duma's Committee on Natural Resources and Environment, said that the water supply in Crimea cannot be solved by diverting water from the Don or the Kuban rivers. He also pointed out that the Caucasus and the Krasnodar Territory itself suffer from water shortages, and that the sources there could supply fresh water to the city of Kerch, i.e. 157,000 people at most.[186]

Interestingly, at the end of March 2014, the head of the Ukrainian State Water Agency, Vasiliy Stasuk, informed news portal *Korrespondent* that cutting off water supplies to the Russian-occupied Crimea was not on agenda at all. This would lead to an immediate disaster, as supplying the nearly 2.5 million inhabitants of the breakaway and then still autonomous republic with water by boat would be an impossible task, even for the mighty Russian Federation.[187] Today, this attitude has officially changed. The Ukrainian position is that restarting the water supply would be tantamount to recognising the occupation of Crimea.

To solve the problem detailed above, the technical sub-unit of the Armed Forces of the Russian Federation has started the construction of a water pipeline to help supply water to the peninsula. Soldiers from one of the army's

[186] MTI 2014.
[187] Palkó 2014.

technical battalions constructed eight pipelines, laying some 8,000 pipe elements, connecting the artesian wells to the canal for the water transfer. The total project involved laying 48 pipelines to ensure a continuous supply of 500,000 m^3 of water per day. The works involved 500 people and 200 technical machines.[188] The Russian Government has earmarked 65.7 billion roubles (263 billion HUF) for the solution of the peninsula's water supply between 2015 and 2020. This was to build water catchment areas, reservoirs and artesian wells (69 facilities in total). The plan did not work, so the budget was increased to 87.5 billion roubles, while the number of facilities to be built by 2020 was reduced by 21.[189]

In February 2020, the city of Simferopol announced that it had enough fresh water for 100 days, meaning that it was unable to supply the population. The water supply problem has therefore not been resolved satisfactorily. There are of course economic, political and security implications. With regard to the latter, suffice it to say that the quality of the water supply is also affected by the ever-increasing Russian military presence in the area. While 12,500 Russian troops were serving in Crimea in 2014, there were 31,500 there in 2019. This number, excluding family members, requires a minimum of 2.6 million m^3 of water per year.[190]

Ukrainians do not deny that they fear Moscow is trying to use military force to gain full control of the North Crimean Canal to secure the peninsula's water supply, extending its influence into new Ukrainian territories.[191]

The situation has not improved recently and tensions continue to persist. In the five years since its annexation, Crimea has received 1,500 billion roubles in aid, which is just as much as the Russian budget spends on education in two years. In 2021 alone, 1.4 billion USD was envisaged. However, these funds have to be diverted from other important areas. The issue of drinking water could be solved in Ukraine, but President Zelensky insists that the closed

[188] RT 2015.
[189] Komócsin–Barabás 2020.
[190] Lukashova–Reshchuk 2020.
[191] Goble 2020.

Northern Crimean Canal will only be opened if the Russians withdraw from Crimea. Severe water supply problems have led to a situation where Crimea had 130,000 hectares of arable land in 2013, but in 2017 it was only 14,000 hectares, a fraction of the land it had in Soviet times.[192]

The role of drinking water in the Middle East

Security experts agree that gaining and retaining control of water resources is the key to success in the military conflict in Iraq and Syria. In water-poor areas, rivers, canals, wells, springs and water facilities are prime military targets for any belligerent party. Drinking water is a strategic asset, the possession of which is essential to achieving sustained success in military operations.

Although the fighting has met with varying degrees of success, the Islamic State holds a number of areas and objects important for the region's water supply, which it has deliberately taken control of. The Tigris and the Euphrates, the region's main watercourses, are highly vulnerable in this respect. According to many experts, the possession of water resources is more important than the region's oil deposits, industrial facilities or warehouses. Depriving the enemy of drinking water will cause immediate health and supply issues, which could ultimately lead to collapse. It is no coincidence that in 2003 the US invasion also made the seizure of hydroelectric power plants and other water facilities a priority.

Islamic State fighters gained a major strategic advantage by seizing a dam near Fallujah in April 2014. The occupied dam is located about five kilometres from the city.

The attackers gradually blocked 8 of the 10 floodgates on the dam, causing the Euphrates to flow out of its channel and flood the area. This has significantly reduced the Iraqi army's manoeuvrability and made the homes of 12,000 families uninhabitable. At the same time, water supplies were

[192] Siklós 2021.

disrupted in the lower reaches of the river and the drop in water levels led to power cuts in towns south of Baghdad, where power stations are heavily affected by the river's water level. The Iraqi military leadership responded to the situation with an immediate counter-attack.

In June 2015, water was again used as a weapon by Islamic State militants. They blocked a dam on the Euphrates River to facilitate their attacks on the government. What gives them more room to manoeuvre is a reduced water supply for the inhabitants of the southern provinces.

So far, the river has served as a natural barrier between the attackers and government forces. A spokesman for the governor of Anbar province said they would be forced to deploy troops back to the shoreline to avoid invasions. Previously, it was sufficient to watch certain areas and bridges, but now the whole river has become passable. Local experts say two sluices have been left open on the dam to prevent flooding of the areas they control. The government has opened another dam that will allow water from Lake Habbaniyah to flow into the Euphrates, preventing water shortages further south. However, this is a temporary solution that is operational for up to three days.[193]

Water restrictions are used as a tool by all belligerent parties. The Kurds have cut off the water supply to Mosul, the Turks have reduced the amount of water coming from Lake Asad, cutting off Aleppo from fresh water, and the Islamic State regularly blocks water supplies to refugee camps.

Experts agree that the possession of water in the region equates to the possession of power. The Tigris and the Euphrates are the dominant rivers in the region, so the Turkish power plants and dams built on them are key, because of the amount of water they allow other countries to use. Since 1975, Iraq and Syria have been receiving 80% and 40% less water than before. Some experts predict that the two major rivers will not reach the sea by 2040 due to increasing drought and decreasing rainfall.[194]

The driest period in 50 years was one of the triggers of the civil war in Syria. The drought has had a devastating impact on agriculture in the northeastern region

[193] Népszava 2015.
[194] Vidal 2014.

of the country. Farmers began to tap reservoirs en masse, but the water level soon dropped so low that they could no longer pump water out of the reservoirs. In some areas agriculture was completely ruined, in others three quarters of the crops were lost. 85% of livestock died of hunger or thirst. Observers and UN experts estimate that 2–3 million of Syria's rural population of 10 million have been reduced to extreme poverty. Around 1.5 million have left the countryside behind and moved to the cities, already under stress from rapid population growth and the influx of Iraqi refugees. The situation has been exacerbated by poor management of groundwater and discontent over misguided agricultural objectives. All this led to the initially peaceful protests turning into a bloody civil war.[195]

Israel

The problem of the distribution of water resources between Israel and the Palestinians remains unresolved and is becoming increasingly serious. The situation is aggravated by the very low rainfall in the region in recent years, a trend that is unlikely to change in the future. However, climate change and population growth are putting increasing pressure on the parties to work together to address the water supply in the region.

The Palestinians' water resources are under Israeli control and the distribution and use of these resources is fundamentally unequal. While the average Palestinian consumes 66 litres of water a day, the daily per capita water consumption in Israel is 230 litres. (The minimum per capita water requirement is 100 litres per day, according to the World Health Organisation [WHO] guidelines). Drought and water depletion are exacerbating the problem of water supply. The basic problem is that more water is used in the Israeli and Palestinian territories each year than is naturally recycled.

The water supply for Israel and the West Bank comes from the mountainous aquifer that runs along the West Bank. This sedimentary aquifer

[195] MTI 2015.

stretches west, north and east, with the greatest controversy taking place around the western extent of the aquifer. The eastern aquifer, which lies solely under the West Bank, is used by both Palestinian farmers and Jewish settlers.

The near-shore aquifers are now almost completely depleted, and Israel's water supply is increasingly dependent on mountain aquifers. The coastal areas have been dug down to the point where salt water has infiltrated drinking water supplies. In turn, mountain aquifers may dry up as a result of deep drilling.

The Jordan River is another potential, but very limited, source of water in the region. The upper reaches of the river, fed by several smaller tributaries, still provide good quality water, but this increasingly worsens towards the south.

The 1967 Six Day War made a big difference to the Palestinians' water supply. Prior to 1967, the West Bank was governed by Jordanian law, and water was considered private property. The same was the case in the Gaza Strip, where Egyptian law applied.

However, Israeli law treats water sources as public goods. As a result, after the war, water supply systems in the West Bank were nationalised and quotas were imposed on Palestinians to avoid depletion. After the war, the Israeli Government designated the water resources of the occupied territories as strategic resources and placed them under military control. From then on, the Palestinians were not allowed to expand their resources, and drilling of new wells was prohibited by the Israeli authorities. Meanwhile, the Israelis have drilled wells hundreds of metres deep in the occupied territories to supply water to Jewish settlements. The Palestinian wells, on the other hand, are only 60 to 150 metres deep, thus the Israelis have access to much more water and dry up Palestinian farmers' wells with deep drilling.

Israel changed its approach to the issue of water resources in the 1990s. Since then, water has been seen not as a purely strategic resource, but as a potential tool for cooperation. This paradigm shift may be due, among other things, to the drought of 1986 and 1992, which increasingly made water a financial issue. The problem was also driven by the emergence of environmental awareness and the inclusion of water sharing in the peace negotiations. The issue of resources was discussed in Madrid in 1991 and in Oslo in 1995,

but the definition of the right to water was always postponed. One of the main difficulties in resolving the water issue is that countries would have to cooperate and build institutions that would reduce national sovereignty.

The green movements opened up a new perspective on the environment and had a major impact on policy in Western Europe and the United States in the 1970s. Environmental activists made sustainability their code word and encouraged economists to take environmental concerns into account. While these movements gave water a significant economic and environmental value in the West, in the Middle East this view is almost unknown, and in the Islamic religion water is seen as having a fundamentally social significance.

A new generation of Israeli politicians is now aware that the water resources debate will neither change the geography nor solve the crisis. This is why, within the framework of economic cooperation, the sustainable development of the environment is increasingly coming to the forefront, as a way of averting long-standing conflicts.

The military conflicts began on 15 May 1948, when the first Arab–Israeli war broke out. During the war, which lasted for almost a year, Israel managed to hold on to the headwaters of the Jordan River, but Syria and Jordan already held the precious water resources to the south of it. In the early 1950s, Israel announced that it would build a reservoir at the source of the Jordan River. This would have put Jordan and Syria in a very unfavourable position, so the two countries turned to the UN. Even the United States voted in the Security Council to stop the project, which Israel did. However, after the failure of the US water-sharing proposals, construction was restarted and was completed by the early 1960s, and remains one of the country's water supply bases to this day.

The next conflict erupted in 1964, when Syria announced the diversion of the Hasbani and Banias rivers. However, in response to strong Israeli military action, Syria abandoned its ideas, but this was a direct precursor to the 1967 confrontation. During the so-called Six Day War, Israel gained a much more advantageous position by seizing water resources and river basins, especially from Syria. By occupying the western part of the Golan, it took control of the whole

of the Jordan and a large part of the Banias and Yarmuk rivers. Syria was left with no way of influencing the water supply of the Jewish state and was forced to double its use of water from the Yarmuk. However, Jordan was the worst hit by the war, as its share of both the Jordan and the Yarmuk was reduced by a third, leaving the western parts of the country even more water scarce.

In the 1982 Israeli–Lebanon war, Israel occupied the southern part of Lebanon and kept it under occupation until 2000 – this is where the Litani River and its basin are located. During the occupation, there were numerous accusations that the Israelis were pumping water through pipelines into other rivers running into Israel, but no evidence of this was found after the withdrawal.

The new Lebanese water policy was the basis of the 2002 *Vezzani incident*. From the Vezzani River, which feeds the Jordan River, the Lebanese Government wanted to pump 3.65 million m^3 water per year to supply drinking water to the municipalities in the region. However, this amount was so large that it threatened Israel's water supply, creating a new war emergency. Under international pressure, the situation was resolved, and Lebanon opted for a more sensible solution and built its water extraction system, thus also dissuading Israel from armed intervention.[196]

In October 2021, the Israeli Government announced that its annual report to the National Security Council will focus on the impact of climate change, with a particular focus on extreme weather events that increase Israel's vulnerability. In particular, the impacts on terrorism, mass migration and refugees, the stability of the state and the preparedness of the military are mentioned specifically.

The country learned a lesson from the latter when in January 2020, flooding at the Hatzor airbase in the south of the country caused tens of millions of shekels of damage to F–16 aircraft stationed there.[197]

Israel is also in a unique position, with water crises in Jordan, Iraq and Iran worsening; rising sea levels in the Mediterranean threatening millions of people

[196] Erdei 2010.
[197] Gross 2020.

in Alexandria and the Nile Delta, while the rest of Egypt faces food insecurity; and tropical storms are increasingly frequent in the Persian Gulf states, causing economic and civil devastation. These phenomena are exacerbating internal instability and lack of strong governance in the Middle East, increasing the number of violent internal conflicts within countries and cross-border conflicts, as well as the risk of poverty, humanitarian, migration and refugee crises.[198]

The struggle of Egypt and Ethiopia for the waters of the Nile

The waters of the Nile have always been of strategic importance in the life of Egypt. Any initiative to further distribute, divert or reduce the volume of fresh water is a matter of national security. Egypt and Ethiopia have a long-standing dispute over the use and diversion of water from the mighty river.

The conflict escalated when, despite Egypt's continued protests, Ethiopia began construction of Africa's largest dam and hydroelectric power plant (officially known as the Great Ethiopian Renaissance Dam) on the Nile (Figure 15).

The Ethiopian project, which is being built close to the Sudanese border and 1,000 kilometres from Egypt's southern border, is estimated to cost 4.8 billion USD and is currently 30% complete. Almost 8,500 people have already been involved in the construction of the Blue Nile project. When completed, with an expected delivery date of summer 2023, it will be Africa's largest hydroelectric power plant.

Ethiopia hopes that the continent's largest hydroelectric power plant will provide the country with sufficient and cheap electricity, and that it will keep vast quantities of the water that is an extraordinary natural asset and life-sustaining resource on Ethiopian soil.

The water treaties for the region, signed back in colonial times, were entirely in favour of Egypt and Sudan for the Nile. Ethiopia wants to change this by building a huge hydroelectric power station.

[198] Efron et al. 2021.

Figure 15. *The site of the dam built on the Blue Nile*

Source: Firigato 2020

However, Egypt continues to refer to the 1929 treaty with the former British Empire. Under this treaty, no state may carry out any investment on the Nile or its banks that would reduce the amount of water entering Egypt. In Cairo's understanding, it is not allowed to steal water from the Nile or from Egypt. As a result, Cairo considers any attempt to change the terms of the colonial era document an act of war against Egypt.

Ethiopia is doing its utmost to eradicate the colonial legacy of the Nile. Addis Ababa argues that more than 80% of the river's water originates in Ethiopian territory. It promises that the diversion will not affect the Nile's flow, and that protesting and sabre-rattling Egypt will not be deprived of a single litre. Cairo does not believe this, and fears that 'tapping' the Nile will cause serious economic, social and other problems in Egypt. The Nile is a lifeline for the country, with a quarter of its population living in the fertile and gradually developing riparian areas.

The Egyptian political leadership considers full control of the Nile to be a national security interest. Cairo argues that the Nile delta, one of Egypt's most important food-producing areas since ancient times, is already short of water because of the river's drying up due to construction in Ethiopia. Cairo fears that once the dam is built, the Nile will no longer be the same river that fed Egypt's population for thousands of years. It says that once the dam and the power plant are completed, much of the Nile's water will remain in Ethiopia, putting Egypt's potable water supply at risk.

And Egypt's leaders are not willing to accept this. During the term of former Egyptian President Mohamed Morsi (2012–2013), the situation between the two countries was already strained to the breaking point. Morsi did not even refrain from a military attack on Ethiopia because of the extremely problematic situation. At the time, the former president was urged by several of his co-politicians and military leaders to allow sabotage operations, which they believed could have diverted Ethiopia from its dam-building plans. Egypt's situation is complicated by the fact that the power plant under construction is quite remote, so that the only military options are air strikes or the deployment of special operations forces. The former is made more difficult by the distance, as the plant is beyond the reach of the Egyptian air force. The country has no aerial refuelling capacity, so it could only strike the site using Sudanese airfields. However, this would cause further complications, as it would involve Sudan in the military conflict. The use of special operations forces is called into question by the effectiveness of the possible destruction. In other words, could military demolition teams cause damage that would substantially reverse or halt the construction of the plant?

At the same time, Ethiopian military leaders have been quick to declare that they are prepared to defend the power plant under construction with military means, and that the attackers will pay a hefty price for any military intervention.

Despite numerous negotiations, Egypt and Ethiopia have still not been able to reach an agreement, and the European Union was recently asked to help find a solution. Following the decision to invite Brussels to mediate, Egyptian Foreign Minister Nabil Fahmi confirmed that both countries agree that it is time to put an end to the matter and conclude a mutually beneficial and positive agreement. He noted, however, that the Nile waters are "a top national security matter" for Egypt, and therefore Cairo "reserves the right to consider various technical, diplomatic and legal measures to oppose the construction of the dam".[199]

India–Pakistan conflict

The biggest obstacle to reconciliation between India and Pakistan is the clarification of sovereignty over the still unsettled Kashmir province. The territory is currently divided, and India, Pakistan and China exercise sovereignty over the province. As the region's population is predominantly Muslim, Pakistan is claiming control over the whole of Kashmir, but India would not want to hear of it. India controls most of the region: Jammu, the Kashmir Valley, Ladakh and the Siakh Glacier. Pakistan controls the northern hinterland of Muzaffarabad, Gilgit and Baltistan. The part belonging to China is called Aksai Chin (Figure 16).

The dispute between the two countries over the Kashmir region seems to be unresolvable mainly because of the Indus headwaters. Despite India and Pakistan's territorial disputes, the successful respecting of the Indus Water Treaty (IWT) has long been a positive example of cooperation. The 1960 agreement divided the five tributaries feeding the Indus River between the two countries: the Jhelum and Chenab (and the Indus) rivers in the western

[199] Szabó 2014.

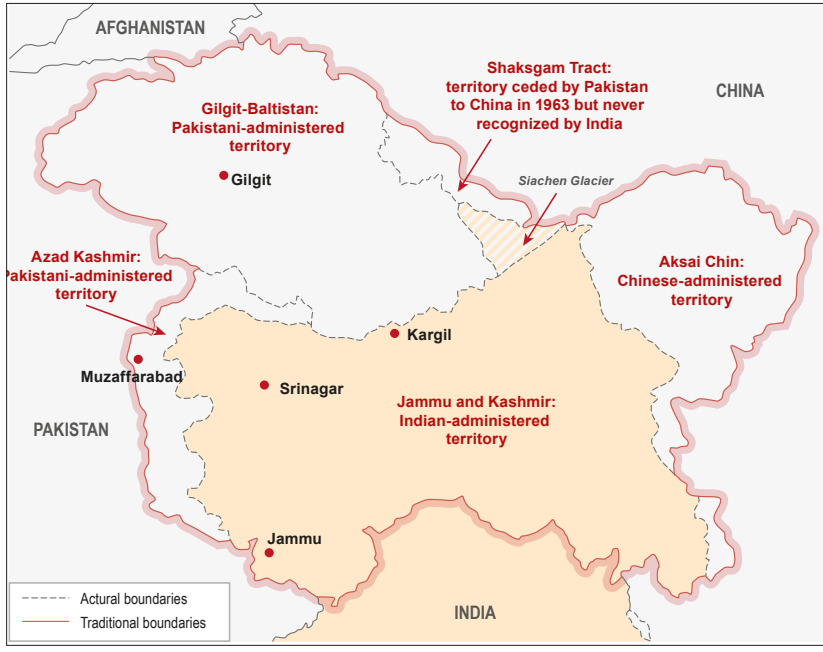

Figure 16. *Kashmir*

Source: Creative Commons

part belong to Pakistan, while India was given exclusive rights to the waters of the Ravi, Beas and Sutlej in the eastern part. Experts say the reason that the parties have so far adhered to the strict treaty terms for water retention is that a large-scale reduction in water yields in the fragile region could lead to war. The President of Pakistan warned against this in 2008, when the Indian Prime Minister inaugurated the 450 megawatt Baglihar Dam on the Chenab River, which Pakistan claims has diverted water from its territory. In India's latest 1.6 billion USD Kishanganga project, it is building another high-capacity dam, this time on the Jhelum River, again in violation of the 1960 agreement.[200]

[200] Bhaskar 2018.

Pakistan's agriculture depends crucially on the river's water yield, which is estimated to fall by 8% by 2050. This is due to dwindling glaciers caused by climate change, but these interventions also play a role in the declining flow, which is still 6,000 m^3/second today. Pakistan now considers the conservation of Indus water yield a matter national security. "They shout that water must flow or blood must flow", say the extremists, which accurately reflects the scale of the tension in a region where nuclear powers are facing each other.

The strategic role of the Tibetan Plateau in water supply

The Tibetan issue has been unresolved for decades. In the 1990s, the Chinese authorities tried to ease tensions with major developments and mass Chinese resettlement. Why is Tibet so important to China? Even Mao Zedong recognised the exceptional strategic nature of the 2.4 million square kilometre Tibetan plateau as a geographical buffer zone. It lies between China and India, and China and Afghanistan.

Another reason is Tibet's invaluable water resources. The altitude of 4,500 metres ensures the excellent quality of the water, keeping it fresh. The Tibetan Plateau has the largest water supply after the Arctic and Antarctic, hence the name "third pole". Several rivers start their long journey from here; the Yellow River, Yangtze, Mekong, Salween, Sutlej and Brahmaputra (Figure 17).

The Tibetan Plateau supplies water to about half the world's population. China's geography is not so fortunate, with frequent droughts and a quarter of the country covered by desert. Most of the country's rivers are polluted, and the water supply outside Tibet is far from sufficient to meet the needs of its 1.3 billion people. One of China's key strategic ambitions is to divert Tibetan water to the richer eastern part of the country. Huge investments have therefore been made to build dams, canals, irrigation systems and pipelines and to adopt various water diversion plans. In the past five years, China has built more dams than the rest of the world put together. It should not be

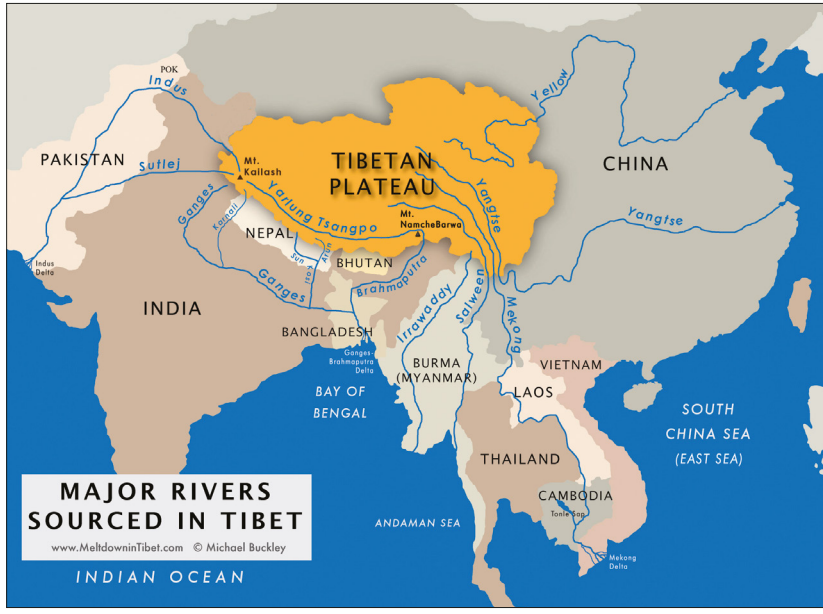

Figure 17. *The importance of the Tibetan Plateau in the region's water supply*
Source: Contact Magazine 2017

forgotten that China has 20% of the world's population but only 6% of the planet's freshwater resources.[201]

In a book, world-renowned Indian analyst Brahma Chellaney argued that Asia's next armed conflict will be over dwindling water resources, with China using its own means to exploit the potential of Tibet. Nor should it be forgotten that, as Tibet's water is diverted, the other states in the region will have less and less. India and Bangladesh already feel the effects.[202]

One typical source of conflict is the use of water from the Mekong River. Given that the key issue is the cooperation of the countries concerned, or the lack of it; it is worth briefly reviewing this.

[201] Australian Security Leaders Climate Group 2021: 32.
[202] Rónay 2014.

The catchment area of the river, which snakes from the Tibetan Plateau to the South China Sea, covers essentially the whole of Southeast Asia. There was already an agreement between Vietnam, Thailand, Laos and Cambodia with a view to develop the Mekong Basin as early as 1957, but it was not until much later, in 1995, that an agreement was reached to create the Mekong Commission. The main tasks of the Commission are to promote discussion of issues affecting the river, to support research and development of the river and its region, to liaise with NGOs and to coordinate joint projects. China is not a member of the Mekong Commission, but is open to discussions in some areas, such as flood protection. China is a key player in any decision affecting the Mekong, as it is the upstream country that decides how much water to allow further down. It has the means to do so, as it plans to build more dams and power plants on the river to control how much water reaches the people of Laos, Cambodia and Vietnam.[203]

Iran

Iran's situation is unusual in many ways. The increasing demand for water, the deterioration of the natural environment, the inadequate management of water resources and the embargo measures, both together and separately, cause the country to have a problem that is hard to solve. Iran's population has grown sharply in recent decades, from 39 million in 1980 to nearly 83 million today. Huge hydroelectric power plants and dams have been built in the country to meet the resulting demand for electricity. The embargo has also made the country self-sufficient in food, which is overburdening the environment beyond the potential of agriculture. Agriculture consumes 92% of the country's water, and intensive agricultural production and wasteful irrigation techniques add to the pressure on water resources. Illegal water abstraction in agriculture is another major burden.

[203] Kákai et al. 2019: 104–124.

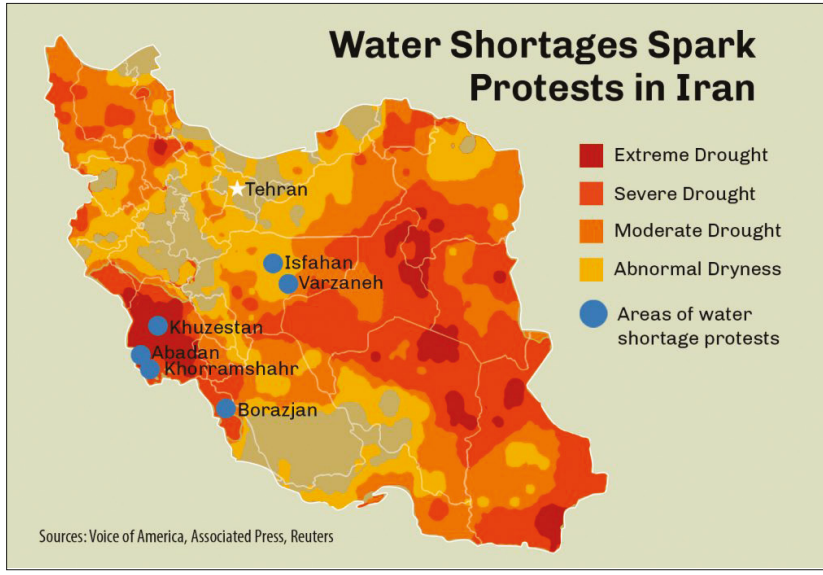

Figure 18. *Iran's climate and the locations of protests*
Source: Maxwell 2018

The problem is not a new one, the country has been facing water scarcity since the 20th century. In addition to natural changes, this was also due to failed industrial development, which caused 85% of groundwater to disappear. It follows that, if this misguided practice continues, 70% of the population, in other words around 56 million Iranians, will have to migrate to other areas.[204] It does not take much imagination to see the security risk that such an exodus poses to the region, and perhaps globally.

The country's situation is complicated by the fact that the region is one of the most exposed to climate change. Declining rainfall, higher temperatures, desertification and extreme weather are putting the country's water supply under constant pressure. Intensive burning of fossil fuels contributes to

[204] Origo 2021.

biodiversity loss and increased water pollution. Renewable water resources have declined by 25% over the last 50 years to less than 100 billion m^3. In addition, temperatures have risen by 1.1°C in the last 15 years, further reducing moisture and increasing evaporation. Experts say that if current trends in global temperatures continue, developments could seriously exacerbate tensions over water, not only within Iran but also between neighbours.[205]

Conflicts over transboundary water resources include disputes with Afghanistan over the Helmand and Hari-Rud rivers, conflicts with other riparian nations over the Caspian Sea, and disputes over the Euphrates–Tigris rivers, which Iran shares with Turkey, Iraq and Syria.

Sistan and Baluchistan, bordering Pakistan and Afghanistan, is the largest Iranian province, with 2.5 million inhabitants. Life in the region depends largely on the waters of Lake Hamun and the wetlands fed by the Helmand River. Lake Hamun, the largest freshwater lake in the country, once covered an area of 4,000 square kilometres. It was declared one of the world's most important wetlands under the 1975 Ramsar Convention. Unfortunately, contrary to the convention's written expectations, the lake's surface area is shrinking, its surroundings are becoming desert and 30% of the population who used to live there have already moved away.

The country's leadership must take immediate action to alleviate the water crisis. This includes conserving existing water resources and supporting sustainable agriculture and industry, and last but not least, reaching an agreement with neighbours on the use of shared water resources as soon as possible.[206] This is all the more urgent as discontent over water shortages in some parts of the country has led to protests (Figure 18). On 26 November 2021, a riot with several fatalities broke out in the third largest city in Iran, Isfahan. For years, disgruntled local farmers have resented that water from the local river is used elsewhere.

[205] Origo 2021.
[206] Origo 2021.

MILITARY RESEARCH

The idea of influencing the weather goes back thousands of years. On the eve of the Trojan War, Agamemnon was forced to sacrifice his daughter Iphigenia in Aulis. The sacrifice was to appease the goddess Artemis, who stopped the winds from blowing, paralysing the Achaean fleet. In the Middle Ages and the dawn of the modern age, of course, witches were accused of controlling the weather. For example, a few witches were accused of conspiring to assassinate King James VI of Scotland (who was also James I of England) at the turn of the 16th and 17th centuries, when they used black magic to create a storm at sea to sink the king's ship. In the Middle Ages, the Finns were often accused of controlling the weather, which is why the Vikings were reluctant to take Finns with them on their conquests. This superstition was so ingrained in the minds of sailors that even in the early 20th century, sailors were reluctant to allow Finns on board their ships.

The first idea to influence the climate may have been conceived by János Neumann, who devised a theoretically feasible plan in case the Earth drifted into another ice age. After a while, climate cooling becomes a self-generating process. White snow trapped on the surface changes the reflectivity of the land, so the ground absorbs less sunlight and the cooling intensifies. Neumann's idea is that we should therefore cover the white surface of glaciers with soot or other dark material.

One had to wait for the emergence of weather modification techniques that could be tested in practice until the end of World War II. The only method routinely used to change the weather was "cloud seeding". The process involves helping water vapour to condense and freeze into ice (in the absence of condensation nuclei, the starting points for ice formation, water remains liquid even at sub-zero temperatures). The technique of cloud seeding was developed by the American chemist and meteorologist Vincent Schaefer in 1946. He used dry ice to cool a cloud containing liquid water suddenly, to colder than 0°C, causing it to condense and freeze. A month after the discovery, Schaefer's colleague Bernard Vonnegut (Kurt Vonnegut's brother) developed

the other technique still in use today. He sprayed silver iodide, which has a crystal structure similar to ice, into the cloud, so that it could serve as a nucleus for ice formation. Since then, a number of other materials have proved useful in promoting cloud formation, and recent research suggests that the use of (hygroscopic) substances with high water-binding capacity, such as salt, seems promising in so-called warm clouds.

As with technical developments with large-scale impact in general, rain-making has not escaped the attention of military engineers. The armies of many countries have probably attempted to manipulate the weather for military purposes, but most of the data on such initiatives by the US military have been made public. During the Vietnam War, between 1967 and 1972, US Army aircraft regularly sprayed silver iodide on rain clouds in North Vietnam and Laos over the Ho Chi Minh Trail, the supply route for the communist forces, in what was known as Operation *Popeye.* Their activities extended the monsoon season by an average of 30–45 days. The rains caused landslides and turned roads into a sea of mud, slowing traffic. An army officer described the strategy as a twist on the anti-war hippie movement's slogan "Make love, not war!", with the bon mot "Make mud, not war!". Conspiracy theorists also saw cloud-spraying planes in the sky during the 1969 Woodstock festival, accusing them of making it rain during the distinctly pacifist event.

In 1977, the Environmental Modification Convention was signed in Geneva, banning the use of similar methods in war. Cloud seeding has therefore been in use for decades, with more than 150 weather modification projects currently underway in 40 countries around the world. Strangely, however, there is little experimental evidence that the inputs actually cause rain, rather than being just a coincidence. In China, for example, according to *New Scientist,* 100 million USD a year is spent on such programmes without verifying their effectiveness using objective measures.

In Hungary, a programme has been in place since 1976 to influence the weather and specifically to protect against hailstorms. The National Ice Mitigation System, consisting of 986 ground generators (219 automatic and 767 manual), started operating in 2018. It works by forming a thunderstorm cloud from the moist-warm

air flowing up from the 1–2 km layer near the ground. When this air layer flows upwards, it carries with it silver iodide from the ground generators, which then acts as an artificial ice core in the cloud. This allows us to reduce the size of the ice particles that form in the atmosphere, thus reducing the potential damage.[207]

In the fight against global climate change, grandiose plans are being drawn up almost daily, which those who devise them believe could be the solution to the problems caused by a warming climate. Rising ocean temperatures are already causing damage in terms of human lives and billions of dollars, as hurricanes become noticeably more frequent and intense. Most modern attempts to influence the weather are aimed at mitigating hurricanes, cyclones and typhoons. So we know how these storms form, all we have to do is cool the seas, and the hurricanes are nipped in the bud. If anything, this plan is easier to devise than to implement, and yet the authors of a recent patent (including Microsoft founder, Bill Gates) are proposing just that, writes *Popular Science* magazine. They would launch a huge fleet of ships that would mix warm water from the surface with cold water brought up from the depths. Over the cooled ocean, fewer, weaker hurricanes would form. The huge costs of the plan, even if it were theoretically feasible, would be met by insurance premiums collected in hurricane-affected areas.[208]

Military research on weather modification is difficult to present objectively. On the one hand, the results are not presented at international conferences, and on the other hand, closely related to the previous one, dozens of conspiracy theories are now linked to this field. In the following, we have tried to present examples that have been officially acknowledged or confirmed by independent and respected experts.

Military research on weather is mainly conducted in countries that, because of their geographically extensive involvement, already have direct experience of the threat or expect to gain military advantage from influencing the climate.

The US military has been working on weather modification for at least 30 years. Their researchers have carried out tests to bring on rain, but they have also tried to create lightning, trigger hurricanes and artificially induce earthquakes.

[207] Szobonya 2020.
[208] Molnár 2009.

We know from expert statements that military research is under way to develop weapons that use lasers and chemicals that would simply destroy the ozone layer over an enemy's head. In 1994, the US Air Force unveiled its *Spacecast 2020* plan to gain control of the weather.[209]

The HAARP *(High-frequency Active Auroral Research Program)* project, supported by the US military, has built the largest short-wave transmitter ever known in remote areas of Alaska. On the project's public website, the potential for restoring the depleted ozone layer and diverting wind storms are cited as key research goals. It talks about the new possibilities of geological scanning studies, which will allow the detection of underground transmission lines and nuclear facilities.[210] Other potential applications can be monitoring submarines and improving the effectiveness of communication with them.

However, the system could also be used to modify the weather using electrostatic fields.[211] Similar technology has reportedly been available in Russia for many years, and the equipment is effective up to 200 miles away. According to independent US experts, the unpublicised part of the HAARP programme clearly serves military purposes. "Worldwide vandalism", said one researcher of the programme.[212]

In 1976, the leaders of the People's Republic of China formally reproached the "Soviet brothers" for "squeezing the clouds" on the border, and the rains that were expected in China all landed on their soil.[213]

Using the weather for military purposes is not a utopia, as evidenced by the fact that the concept of ecological warfare has been created: a conscious,

[209] Manning–Begich 1997.

[210] University of Alaska 2023.

[211] Richard Hoagland, former science adviser to CBS Television, analysed a 1998 mid-Arizona meteorological anomaly. The highly unusual weather phenomenon materialised on December 6 and 7 in sudden fog and heavy snowfall, which resulted in the closure of Highway 17. The phenomenon was not in the forecast and had no discernible link with wind conditions and weather fronts. The longwave activity and weather radar images were compared with the HAARP instrument activity and clear coincidences were found (see VOMIT 2001).

[212] Gilbert 2004.

[213] S. M. 2003.

military intervention in the natural environment, i.e. climate, weather, atmosphere and earth movement, to cause physical, economic or psychological damage to the target group or area.[214]

During the Beijing Olympics, data was made public showing that China can and is willing and able to influence the weather, inspired by the Russians, who invited the Chinese party chief to the World War II commemorations at the turn of the Millennium. He was thus able to witness the effectiveness of military rain dispersal. It was then that the Asian government decided to extend its powers to the weather. To achieve this goal, it purchased a cluster of 80 Power5+ processor-based System p575 servers with 9.8 teraflops of computing capacity from IBM. This supercomputer will be used to model the 44 square kilometres surrounding the event area. The grandiose size of the weather forecasting programme is also reflected in the fact that it employs more than 1,500 engineers and soldiers who can alert any of the 37,000 farmers in the areas surrounding Beijing immediately if necessary. The 30 planes, more than 7,000 anti-aircraft guns and nearly 5,000 rocket launchers deployed in the programme will deliver the right chemicals to the clouds, ensuring that rainfall falls in places far from Beijing and prevents droplets from forming over the city.[215]

The results achieved in military research are also used in other areas. China plans to increase the amount of artificially-generated rainfall by 10% by the middle of the decade, according to the *China Daily* newspaper, which quotes the recently released five-year plan (2011–2015) for the development of meteorology. Currently, only the northeastern province of Jilin has a weather modification programme, which will collect around 50 billion m^3 of artificially-derived rainfall per year. Each year, 3,000 billion m^3 of rainfall passes over the country, but only 20% of this falls in the East Asian country. Using more efficient and extensive methods, the amount of "supplementary obtained" rain and snow could reach 280 billion m^3 per year, according to the China Meteorological Administration.[216]

[214] Chossudovsky 2004.
[215] Pontin 2008.
[216] Világ Figyelő [s. a.].

In addition to Chilin, which went into operation this year, the Chinese leadership plans to set up four more weather programmes in the northwest, south, southwest and north of the country, operating across provinces. Precipitation will be influenced by the same cloud seeding method already used. As part of the plan, a national centre will be set up to manage the intervention, which, in addition to regulation, will be responsible for providing technological assistance, scientific research and the development of weather modification techniques. Weather management is of paramount importance to balance the drought in the country and guarantee crop yields. Setting up new programmes could play an important role in the Centre's plans to increase annual cereal production to 550 million tonnes by 2020.[217]

In the summer of 2021, the Communist Party of China celebrated the 100th anniversary of its foundation. The large-scale event in Beijing to mark the occasion provided another opportunity to intervene in the weather. According to the *South China Morning Post,* a few hours before the mass events, substances were released into the clouds around Beijing to cause rainfall, directly improving the city's air quality. According to researchers, the artificially induced rainfall reduced the amount of pollutants in the air by more than two-thirds. The indicators went from medium to "good" according to World Health Organization standards. Many experts believe that China has built one of the largest and most sophisticated weather modification networks in the world. Meteorological authorities are using satellites, aircraft, mobile radar stations and artificial intelligence to predict the movement of moist air to control when and where it rains. Some researchers worry that large-scale projects could disrupt the weather in other parts of the country, causing more harm than good.[218]

In addition to climate change, there have been many developments in the field of adaptation, which are not unprecedented. As early as 2012, the European Defence Agency called for a reduction in the footprint of military force.[219]

[217] Világ Figyelő [s. a.].
[218] Bozzay 2021.
[219] European Defence Agency 2012.

Accordingly, in addition to the problems of transport, storage and distribution, the focus has shifted to the use of alternative energies in combat, extending right down to the personal equipment of the fighting soldier. In the field, the average energy consumption per fighting soldier is as follows:

- petrol fuel 83 l/person/day
- battery 2 kg/person/day
- electricity 3.6 kW/person/day[220]

In the field of field energy supply, the future challenge is to develop a self-sufficient, sustainable energy system that makes more efficient use of the resources available in the operational area.

A very important area of research is the management of mixed waste generated during the stay in the field. The average amount of this waste is 0.5–3.5 kg/person/day.

This means that a 300-person military camp generates 750 kg of waste per day. The basic aim is to reduce the amount of waste that needs to be taken out, while generating energy. Today, there are mobile waste processing plants and waste generators, which produce energy from dry waste, mainly ethanol.

Five hundred soldiers produce between 1,000 and 2,000 kg of waste per day. The mobile unit burns 2,000 kg of waste and produces 200 kW of power, producing 3,000 litres of hot water per hour, which is equivalent to saving 1,300 litres of diesel per day.

The extreme climate is also driving researchers to new efforts in the development of military clothing. The Chinese army has developed various innovative cold-weather clothing and accessories for its soldiers serving in the Tibetan Plateau. Designed for extreme cold, the equipment has been developed specifically for the army to ensure that patrolling and training can be carried out in extreme conditions. The developments were preceded by extensive research, involving researchers and experts with a good knowledge of local conditions. The new equipment includes a sleeping bag, training clothing,

[220] EDA research database.

brogues, boots and snow jackets. The introduction of new technologies and materials has reduced the weight of the products, but they can also be used at 5,000 metres and in temperatures of minus 40°C.[221]

In response, India immediately began to procure military clothing products that had already proved themselves in similar circumstances. However, this situation has highlighted the fact that the Indian armed forces are lagging far behind in this area and are unable to catch up on their own. Market research was therefore launched in the United States, Australia, Canada and Europe.[222] The first 11,000 sets of clothing material were received from the United States.

Major improvements are also expected in the field of technical equipment, which are closely linked to the concept of the "Greening Force". Last year, Brazilian company Embraer presented plans for a hybrid-powered military aircraft. The light transport plane, called STOUT *(Short Take Off Utility Transport),* will be powered by two conventional turboprop engines and two electric motors mounted on the wingtips. They will be powered by extra generators. As a result, this 21st-century aircraft will be able to make do with significantly less power, and therefore much lower consumption, than a conventional aircraft of comparable power. It is envisaged that the hybrid propulsion system will mean that the operator will not have to compromise on performance, with the STOUT capable of taking off from a runway with a sloping ground surface of just 1,200 metres, carrying and jumping 30 parachutists, but also carrying smaller vehicles or palletised military equipment in its cargo bay, up to a total of three tonnes. It is planned to have a range of 2,425 km.

This is not the distant future; the Brazilian Air Force has already signed a letter of intent in December 2019 to purchase the aircraft to replace its ageing fleet, while also declaring war on emissions. Embraer has also promised that if the new type proves a success with the air force then a version for the civil market will be produced.[223]

[221] Global Times 2020.
[222] Bedi 2020.
[223] Malewar 2020.

On 6 May 1937, after the Hindenburg disaster, it seemed that the zeppelin was finished for good. Even so, there is one advantage that gas-powered vehicles have over aircraft: they consume much less fuel, and that is why they could soon be given a new chance. Over the past 10–15 years, several sources have suggested that the US military might replace cargo planes with airships in the future. They would also be willing to accept that even the most modern airships would certainly be slower than today's transport aircraft. In return, they would be much more environmentally friendly and could carry heavier loads.

What is certain is that Lockheed and DARPA are working together on a design for a cargo airship, the P-971, which could revolutionise air cargo transport. Other manufacturers are also trying to deploy airships. One Californian company is working on a hybrid airship, a rigid-frame aircraft made partly of aluminium and carbon fibre that would be able to take off and land vertically, meaning it would not need a runway, and could carry cargo to the most remote locations. It would also be able to land in bad weather, avoiding the mistakes of the last century, and stay on the ground without the need for tethers. The army hopes that such an airship could carry 500 tonnes of equipment or crew over 22,000 kilometres in seven days. Of course, all this requires a serious engineering effort, so we will have to wait until the good old Hercules retire.[224]

The Cold War arms race gave birth to one of the most bizarre devices in aviation history, the ekranoplan. Also known as a ground effect vehicle (GEV), it exploits a phenomenon known as the cushion effect, which is experienced up to 20 metres off the ground. A high-pressure layer of air is created under the wings of the plane, creating much more favourable flight conditions than at higher altitudes, as recognised by Soviet engineer Rostislav Yevgenyevich Alexeyev, the designer of the ekranoplan. His invention first took to the skies from the Caspian Sea in 1966, and although it was not clear whether it was an aircraft or a ship, its outstanding qualities attracted the attention of the army. The design of the aircraft was significantly more economical than any other transport aircraft in the Soviet Armed Forces, but it was certainly not environmental or economic considerations that

[224] Norris 2016.

drove the fuel-rich Red Army. Rather, it was the fact that the ekranoplan could lift almost 600 tonnes of payload into the air, a record in the 1960s. The programme was eventually cancelled for political reasons, and the idea of a ground effect vehicle seemed to end up on the scrapheap, along with the prototype. However, more recently, not least because of its low fuel consumption, it has begun to be explored, with the Russians already coming up with new designs and, in the US, Boeing starting to design its own ekranoplanes.[225]

Electric or hybrid cars, already well established in the civilian market, could soon play a big role in the military. The British Army is already testing the Foxhound reconnaissance SUV, which is well-proven with a conventional engine, and the Jackal 2 all-purpose open-top SUV, to see how they perform with hybrid and electric power respectively. If the new generation of military vehicle technology proves successful, more than 2,000 armoured vehicles could be equipped with electric or hybrid propulsion systems. Lieutenant General Eric J. Wesley, the US Army's Chief of Staff for Development, also said that he considers it of utmost importance to increase the number of pure electric and hybrid vehicles in the military, if only because of the significant burden on logisticians to organise fossil fuel resupplies. However, he did not conceal the fact that a switch to electric vehicles would not only require replacing the fleet, but also a very serious infrastructure development; for example, regarding portable nuclear power plants, for which the Pentagon is providing 400 million USD.[226]

There is also a long history of research into adaptation. In Florida, a test track (McKinley Climatic Laboratory) was built in 1947 to model extreme weather conditions. It is here that complex systems that are expected to perform under extreme weather conditions are tested. It is not just the military that uses the equipment, government and non-government organisations are also testing, and private companies are not excluded.[227] The lab is the only facility in the world capable of testing a fully operational aircraft in extreme climatic

[225] Ros 2021.
[226] Sybert 2020.
[227] March 2017.

conditions. This facility can simulate any extreme weather environment on any given day at a significantly lower cost than real testing.

Research in the Hungarian Defence Forces

The research programme on climate change and security, in particular the security of military forces, started at the Miklós Zrínyi University of National Defence and was completed at the Ludovika – University of Public Service.

The main objective of the research team was to synthesise the known climate change impacts, to systematise the open questions and to adapt the results that have been proven to be effective to the domestic context, by reviewing the available research results in the national and international literature. All this with the determined aim of enhancing the safety of our soldiers in all aspects of life, be it mission engagement, disaster response or the challenges of everyday life.

Climate change is a "popular" topic, but its impact on the use of military forces has been little discussed in our country. It is necessary to mention here that the publication entitled *Az éghajlatváltozás hatása és a katonai erő* [Climate Change and Military Force], published in 2010 by the Institute for Strategic and Defence Studies, is considered a pioneering work in this field.[228] We continued this idea when we embarked on the two-year research.

The project team includes three academic doctors, six PhDs, two doctoral students and five undergraduate students – a total of 31 people. Our results are impressive, both in terms of quantity and quality. We organised two national conferences, where our researchers gave 18 presentations. We have also presented three times abroad, where we have given further presentations to show that we are researching in this area. We have published 29 articles (eight in foreign languages), three volumes of papers, an online bibliography and an English-language volume. An outstanding achievement was the instrumental examination of all uniforms used in the Hungarian Defence Forces, carried

[228] Kohut et al. 2010.

out in cooperation with the Department of Civil Engineering of the Pollack Mihály Faculty of Engineering and Informatics of the University of Pécs.

Cooperation has been extensive even beyond this organisation. During the research, we cooperated with the Ministry of Defence, various organisations and units of the Hungarian Defence Forces, and representatives of the civil sector, including several SMEs, and the higher education sector. We worked closely with the NATO Centre of Excellence for Chemical Defence (Vyškov, the Czech Republic).

To achieve our goals, we have continued our research in the following areas:

- processing relevant international and national literature, organising data in a repository
- experience of the use of military force in disaster response
- changing disaster vulnerability as a result of climate change
- the challenges of climate change in chemical defence
- changes in the energy supply and demand of the army, renewable energy sources
- technical equipment and climate change (operation, repair, maintenance, life cycle)
- health aspects of global climate change
- the effects of extreme climatic factors in areas of operations on the psychological–mental performance of soldiers and its physiological effects
- emission reduction options for automotive equipment in the Hungarian Defence Forces
- the *Green Barracks Programme;* the options for renovation of HDF properties
- the impact of global climate change on critical infrastructure protection
- the impact of extreme ambient temperatures on military clothing, and the directions for clothing selection and development
- the impact of climate-induced changes in the natural background on battlefield camouflage

The following is a non-exhaustive summary of the results of some of the sub-areas of research.

The Green Barracks Programme[229]

A good example of research and development in the Hungarian Defence Forces is the *Green Barracks Programme.* The building energy programmes and renewable energy efforts implemented and planned in the army serve both to reduce energy consumption and CO_2 emissions. The modernisation of heating systems, solar hot water production, photovoltaic energy production, installation of advanced building energy systems, conversion to energy efficient modern lighting systems, building management systems and use of rainwater make up this programme.

Of the elements of military infrastructure, it is of course the built real estate (barracks, institutions, storage bases) that plays the most important role in terms of energy-related matters. In terms of magnitude, the real estate portfolio managed by the Ministry of Defence can be characterised by the data in Table 14:

Table 14. *Real estate portfolio managed by the Ministry of Defence*

Number of objects	*Real estate floor area*	*Build-ups*	*Volume of building portfolio*
1,700	118,000 ha	14,500	15,000,000 m^3

Source: Kovács 2013: 69

The above property portfolio is worth 360 billion HUF. The technical condition of the state-owned property portfolio managed by the Ministry of Defence has deteriorated significantly over the last 20 years. This is due to the fact that the annual budget has allocated little or no money for renovation and that maintenance and operating expenses have remained below the required normative levels.

[229] Kovács 2013: 67–82.

The 1,700 or so facilities used by the army have more than 14,000 buildings with an air volume of almost 15 million m^3. The aggregated annual energy consumption figures for the operation of these facilities are shown in Table 15.

Table 15. *Energy consumption data*

Electricity (kWh)	*Natural gas (m^3)*	*District heating (GJ)*	*Fuel oil, residual fuel oil (litres)*	*Coal (ton)*
82,680,000	26,650,000	170,300	700,000	2,200

Source: Kovács 2013: 72

The cost of the energy used in its operation is currently more than 8 billion HUF per year. These consumption figures illustrate the significant cost savings that could be made by rationalising energy use in the Ministry's property portfolio, which, even at 12–15%, would represent billions of euros.

Even in the current difficult, underfunded situation of military infrastructure, programmes and resources must be found to raise current technical standards, improve energy conditions, and achieve energy savings and reduced carbon emissions. This is why the *Green Barracks Programme* was created.

The programme also includes the introduction of alternative energy sources (biomass, biogas, solar energy, wind energy) for the supply of military facilities, and the use of renewable energy sources for the production of hot water, electricity and heat. The use of green energies and energy saving also extends to military operational areas and camps, where the economic and security aspects of energy issues are also increasingly relevant. Many elements of the military infrastructure are also elements of the national critical infrastructure, so their security and energy issues also serve to protect critical infrastructure.

The *Green Barracks Programme* seeks to offset the increasing energy consumption associated with climate change in the development and maintenance of military infrastructure, while also promoting the use of renewable energy and environmental protection.

Impact of extreme climate on psychological–mental performance[230]

Proper management of environmental factors is crucial to the success and survival of military operations. Understanding the mechanisms by which heat affects cognitive, behavioural and subjective responses is crucial. Heat stress significantly reduces military performance, and psychological changes predict critical physiological changes. Our research has addressed the mental, psychophysiological, physiological and group psychological aspects of psychological performance under the influence of hot climate environments. We have examined changes in cognitive performance, reaction time, perception, alertness, complex mental and psychomotor performance, manual dexterity, endurance, aiming, goal pursuit, simultaneous tasks, subjective reactions, perceptual symptoms and phenomena, sleep rhythms, group psychological processes and emotional readiness in high ambient temperatures. Our main recommendations are:

– Military leaders must become familiar with the basic physiological and psychological phenomena (affecting military performance) associated with the effects of extreme climate environments in order to plan mission operations and to prepare selected personnel physically and psychologically.
– Commanders operating in mission areas need to be provided with relevant data on the local environmental climate and its likely physiological and psychological effects in order to plan individual missions and regular service activities.
– Missions in extreme temperatures lasting more than 3–6 hours must take into account the expected reduction in psychological performance, which can be mitigated by breaking down complex tasks and simplifying communication.
– Commanders in charge of operations need to pay close attention to personnel during missions in extreme temperatures, wet environments and water, as prolonged exposure can lead to a faster and more significant worsening of performance.
– It is recommended that mission commanders should also include in the planned exercises in the areas of operation in the given climate elements to

[230] Hullám 2013: 83–100.

provide information on the current state of psychological performance (in particular on wearing special protective clothing and equipment). Furthermore monitor that clothing, protective equipment, tools and equipment meet the requirements of the given environmental climate and the tasks to be performed in order to protect and maintain the health of the personnel.
- The design and construction of military clothing and protective clothing shall take into account extreme climatic factors and the scientific and practical experience gained from international studies (together with the practical experience of soldiers serving in missions), with particular reference to the properties of the micro-environment between the body and the clothing during wear and its role in thermal regulation.
- It is recommended to wear protective clothing that can reduce the negative effects of sweat and humidity and provide adequate thermal insulation.
- The health service must be prepared to recognise and treat the symptoms and signs of both heat stress and hypothermia. In the mission areas, they need to keep the soldiers' basic knowledge of this subject up to date through their own and comrades' assistance.
- In extreme ambient temperatures, manual grasping and holding skills deteriorate, making manually controlling of certain devices and equipment difficult due to overheating or even extreme cooling of the controls. This may justify the redesign of certain military devices and equipment to suit the specificities of the environmental climate and to take ergonomic aspects into account.

Impact of climate change on ABC (atomic, biological, chemical) protection[231]

Climate change affects people, buildings, vehicles and equipment. ABC protection is affected even more strongly than other disciplines because of the nature of the tasks involved and the circumstances in which they are carried

[231] Földi 2013: 101–116.

out. The expected increase in extreme meteorological situations and natural disasters of meteorological and hydrological origin is expected to increase the number of tasks in the field of civil defence, mainly due to the domino effect.

The use of ABC equipment and its further development must be reviewed to ensure that it continues to meet the changing requirements of climate change. Significant further research and development is expected to be required to provide soldiers with appropriate equipment, such as more modern personalised ABC protective clothing, weapons and electronic devices that can operate reliably in a wider range of ambient temperatures, and effective decontamination technologies and techniques for changing extreme conditions. In parallel, this calls for a necessary transformation of the ABC defence training system.

The potential of renewable energy sources[232]

Alternative or renewable energy sources are being explored all over the world to protect the quality of life. There are many opportunities to transform the resources provided by fossil fuels into energy sources that are not threatened by a relatively limited lifetime, meaning that their continued availability is assured. However, this is not only important because renewable energy sources are continuously available and their use does not pollute the environment or produce gases that attack the Earth's ozone layer and actively contribute to the greenhouse effect, but also because regulations to protect our environment oblige users to avail of alternative energy sources as much as possible.

These types of energy derive their energy content from three different sources. The largest group includes devices that harness the sun's energy (solar panels, solar collectors, wind energy, in part geothermal energy and hydroelectricity), all of which can use the incredible amount of thermal energy released by the sun to produce energy that we can use in our daily lives. In fact, biomass could be included in this group, as the sun also helps plants to grow.

[232] Barbarics–Padányi 2013.

The second group includes energy that is generated by using additional forms of energy that exist, such as tidal power plants that use gravity or geothermal energy that harnesses the Earth's internal energy.

The third group includes resources that enable the use of materials that are generated by life on Earth and are not currently in everyday use, such as biomass or waste processing.

If we look at everyday life, it is relatively easy to use any renewable energy source, depending of course on the geographical location, and make significant savings on electricity or heating bills, depending on the type of solution used, not to mention the fact that we are not polluting the planet's atmosphere further by using these forms of energy.

However, there are many constraints on the life and requirements of the military, because even with a base in its own country, the security of the installation, both against external enemies and for internal security, is essential, as it is not acceptable for a military base to be left without electricity.

Taking these requirements into account imposes severe constraints on the use of alternative energy sources, and consequently, there are some types of energy that, however cost-effective, are not feasible under the circumstances.

Looking at the solutions detailed above, we can conclude that a solar panel that directly harnesses the sun's energy and provides direct electricity would be the first choice in the feasibility studies. This would be the equipment that could be used to the maximum extent, either for bases in the home country or for a foreign base in hostile territory, as a safe solution to replace fossil fuels. It represents a one-off investment and a one-off transport problem, with no additional fuel requirements once installed. Maintenance costs are also relatively low, as the solar panel itself does not actually require maintenance, but rather in-service inspections of the inverter and/or battery cells located in a protected space.

For a foreign base, solar is practically the only recommended equipment, as all others have significantly lower savings and significantly more safety problems during use. Of course, it is not an appropriate solution to think of using alternative energy as the only source. There are many circumstances

that can negatively affect the energy production potential of a renewable energy source. Such a problem can occur for a solar panel if there are several consecutive days of cloudy, rainy or at least very overcast skies. In such cases, the solar panels do not receive enough radiation and are not able to produce the right amount of energy. The only way to avoid this problem for the time being (since, unfortunately, electricity storage is not yet easily and locally available) is to have a fossil fuel source, typically petroleum derivatives, with the same capacity as the alternative energy source, available in operational readiness. This means that old, well-proven equipment cannot be discarded, as it may still be needed in case of problems, but that actual energy production needs to be re-routed towards alternative energy sources.

For domestic bases, the range of energy sources that can be used is significantly extended. It is certainly reasonable in this context to use both the systems offered by solar collectors for heating and hot water, wind power plants for generating cheap electricity and, given the country's extremely rich thermal water resources, geothermal energy, which offers a secure return and significant fossil energy savings.

In Hungary, security is provided by the existing distribution systems to which the bases are connected, so alternative energy sources can be used to reduce the cost of energy used and to increase environmental protection, but, with major investments, it is also possible to make a profit by increasing the energy production capacity if the equipment is used well.

And we cannot forget the energy from biomass and waste processing. The use of these products is also in its infancy in our country, and there is still a lot of potential as a reserve. In any case, it would be useful to plan how much energy, in addition to the use of solar collectors and geothermal energy, would be required for existing heating and hot water systems if the necessary energy were to be produced using biomass (e.g. pellets) or even waste from the base area instead of fossil fuels.

Finally, we should mention the two remaining energy sources. Unfortunately, these are alternative energy sources that are impractical or impossible to use in our country. Due to the country's continental location, we have

no coastline, so the use of tidal power plants is out of the question, and at the same time, due to the high proportion of flat land, the fall of rivers and watercourses is very modest, so it is not economical to set up a power plant with a significant yield, especially if we also take into account the fact that the yield of existing rivers has also been falling significantly in recent times due to drought.

Overall, the installation of solar PV systems is what would be strongly recommended to reduce the fossil energy needs of military units and to achieve significant cost savings.

Testing military clothing[233]

Clothes testing needs to be a prime requirement in any profession. There is a well-developed literature on the requirements for the development of workwear; military clothing is no exception, and it can be defined as workwear, from one point of view. In our research in 2014, we basically examined the following three types of garments, provided for the summer, transitional and winter period:

– everyday and social outfits
– forest war (training) outfits
– desert war (training) outfits

A thermal manikin was used to model the thermal comfort of the soldier. The winter and transitional period measurements were made in a refrigerated container placed in front of the Department of Civil Engineering at the University of Pécs (PTE) and the summertime measurements were made in the thermal laboratory of the Department of Civil Engineering at PTE (Figure 19).[234] The ambient temperature and humidity, air velocity and

[233] Magyar et al. 2014.

[234] Today known as the Department of Civil and Plant Engineering, Faculty of Engineering and Information Technology.

thermal camera recordings were measured. Almost 20 million data points were recorded during the measurements. This justified writing an Excel-based program to help organise the data and make the calculations quick and easy.

The evaluation sheet includes a description of the relevant outfit, the measurement conditions, the CLO value of the outfit calculated from the measurement results, and the specific and total performance of the thermal manikin. The specific and total power of each body part is also presented in a graphical form on the evaluation sheets, from which the analysis of each garment can be performed later.

The specific performance of the thermal technician in each suit was determined. If the soldier performs the same activity in all periods (the MET value is the same), the specific power should be constant regardless of the suit. Our key findings are as follows:

- For the training and desert clothing, the specific performance of the thermal manikin in the winter period is higher than the average specific performance of the clothing tested. In order for the thermal manikin to be in thermal equilibrium (PMV = 0, i.e. comfortable), a performance surplus was required. In this case PMV < 0, meaning that the soldier was cold. If some activity is assumed to be performed in the clothing, meaning an activity value of 1.8–2.0 MET, thermal equilibrium is restored.
- For the training and desert clothing, the specific performance of the thermal manikin in the summer period is lower than the average specific performance of the clothing tested. To be in thermal equilibrium (PMV = 0, i.e. comfortable), the thermal manikin would have required less power. In this case, PMV > 0, i.e. the manikin was warm. The thermal manikin is not able to sweat, whereas the human body in this case gives off excess heat production by sweating.
- For the training and desert suits, the measured data are around the average specific performance during the transitional period, i.e. thermal equilibrium has been reached.
- For everyday and social wear, the measured data are around the average specific performance, i.e. thermal equilibrium has been reached.

Figure 19. *Thermal manikin at work*
Source: Picture taken by the author

– The effect of wind is to increase performance, so in this case, in winter, the CLO value of the garment or the increase in activity (MET value) must be provided to ensure thermal equilibrium is reached. In summer, the effect of the wind causes the manikin to reach thermal equilibrium.

The above findings apply to the garment as a whole and do not include an individual examination of each piece of clothing.

In some cases, the measurements with the thermal manikin were compared with measurements with live subjects. In these cases, the measurements with live subjects overall confirmed the results of the measurements with the thermal manikin. The tests also provided additional information on individual garments that can be used as a starting point for further research.

Each type of clothing has been divided into different versions based on temperature. These temperatures at which measurements were taken include summer, transitional and winter wear. For the purpose of the measurements, the winter period is defined as –20°C to 0°C, the transitional period as 0°C to +15°C and the summer period as +15°C to +30°C. The lowest temperature measured was –20°C and the highest temperature measured was +30°C during measurements.

Military clothing has to meet a wide range of requirements, including the most complex requirements. In the following, we present the findings of Marianna Halász, who has studied the measurement report.[235]

- Ensuring the physiological comfort of the soldier's clothing, even under extreme external climatic conditions and under the most varied intensity of activities. These activities can range from hiding motionless for hours on end to activities requiring the performance of a professional athlete without the possibility of changing clothes.
- Military clothing is special workwear. Its design should be appropriate to the activity (according to the branches of the armed forces and the arm of service) and to the usual occupational safety aspects, it should have adequate camouflage and be practical.
- In line with the complexity of military activity, clothing should be ergonomically appropriate: comfortable, tailored to the body (sizing issues!), light, flexible, not impeding movement and bodily functions, easy to put on and take off.
- It must not be harmful to health, not be prone to electrostatic charging, be pleasant to the skin, not rub or irritate the skin during movement, and the raw materials and chemicals used for dyeing, finishing and washing must not be harmful to health or cause an allergic reaction.
- It must meet the aesthetic requirements, express one's belonging to the HDF.
- It should be hygienic, easy to clean, preferably washable and maintainable.

[235] Halász 2014.

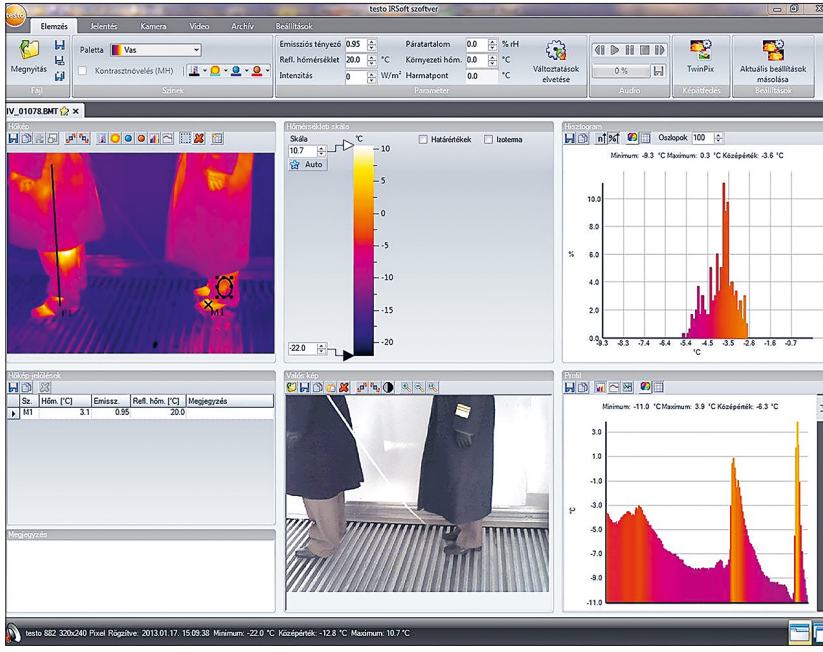

Figure 20. *The measurement screen*

Source: Magyar 2014

– It should have sufficient durability, i.e. mechanical strength, wear resistance, washability and colour fastness, and the material itself should be sufficiently resistant to heat, moisture, UV radiation and micro-organisms (e.g. fungi).
– Military clothing must also have a protective function. As far as possible, it should protect against all external influences to which soldiers may be exposed, such as mechanical impacts, sandstorms, parasites, insects, worms, snakes, chemicals (acids, alkalis, etc.), fire, UV radiation and electric current.

The physiological appropriateness of military clothing is extremely important. Soldiers cannot be expected to perform well if their hands and feet

freeze because of the cold, or if they are unable to concentrate on their task because of the heat. Physiological comfort must be guaranteed even in extreme weather conditions.

However, it is only one of the requirements for military clothing that it must be physiologically appropriate. Compliance with this requirement must be coordinated with compliance with the other requirements.

Unfortunately, ergonomics, durability and, above all, protection are often in conflict with the physiological aspects of clothing, so compromises have to be made when designing military clothing. The aim is therefore to try to improve the physiological adequacy of military clothing while at the same time meeting the other requirements, in particular those relating to the safety of the soldier (Figure 20).

Ergonomic aspects in relation to clothing physiology

From an ergonomic point of view, the clothing must be comfortable, fit the body, be light, flexible, not impede movement and bodily functions, and be easy to put on and take off.

For comfort, it is very important that the fabric of the garment is flexible and soft. The stiffer or harder the material, the harder it is to move when wearing it. This basically depends on the fibre properties of the fabric, the structure of the fabric and the finishing processes the fabric has undergone. Flexibility is also influenced by the technological processes used in the assembly (e.g. types of stitching, gluing, lining).

Flexibility is also related to the thickness of the material. The thicker the material, the greater its resistance to bending. This brings up the issue of layering. Layering has many advantages, but also disadvantages. Many layers increase the thickness of the garment, which improves its thermal insulation but reduces its flexibility. The consequence of too many layers can be that one is eventually barely able to move around in them. It is therefore necessary to increase the insulating properties of the garment without compromising its flexibility.

For ease of movement, clothing must be as light as possible. The insulating properties of the clothing must hence be improved without increasing the weight of the garment.

Fit is not just an aesthetic issue. The comfort of clothing is closely linked to its fit. A soldier's clothes should not be too tight, but they should not be too baggy either. Clothing that is too tight is an obstacle to movement and bodily functions. Tight clothing wears out much more quickly due to constant strain. Tight clothes are warm in summer and cold in winter because they have no air layer underneath. Too baggy clothes also hinder movement and increase the risk of being caught on something, making them an accident hazard. Clothes that are too baggy are physiologically unhealthy, because the air warmed by the body escapes. Body-fitness can be greatly improved by using stretch fabrics.

Fit is very important for both footwear and gloves. There must be enough space at the toecap of the footwear to allow the soldier to move their toes easily. This allows for more insulating air and movement also helps to keep the feet less cold. Likewise, the gloves cannot be tight, and it must be possible to move one's hands freely inside the gloves. Mittens are also better than five-finger gloves in this respect.

Another important ergonomic aspect is that the clothing should be easy to put on and take off. This is not simply a matter of comfort; in many cases it is a matter of safety. Ease of putting on and taking off is also important for the performance of physical needs. Ease of putting on and taking off depends mainly on the cut of the garment, the way the garment is closed, how it is divided into parts and how many pieces are used.

In the winter, when one wants to take off a layer of clothing without taking off the other layers and shoes, a special closure solution that makes this easier may be important. For example, the two legs of the trousers can be zipped all the way down the sides or front.

Here again the question of layering comes up. Too many layers mean that the soldier has to wear many layers of clothing on top of each other. Layering is usually not easy because they tend to stick together. Care must also be taken

to ensure that the layers are stacked without unnecessary folds or creases, as these can cause pressure later on. For example, if several socks are worn, if creases remain on the socks then they can crack the foot. Therefore, when designing layers of clothing, great care must also be taken to ensure that they are easy to put on and take off.

Successive layers of clothing must also match in terms of size. The top layers always need to be large enough to fit comfortably underneath, so that they can be easily layered on top of each other. It is important that the upper layers do not press the lower layers together, as this reduces the thickness of the enclosed air layer, thus reducing the insulating capacity of the garment. This means that part of the reason for using multiple layers in the first place is lost. Compression can also cause thermal bridging, which again can cause a further loss of insulation in very compressed areas. In addition, compressed layers become increasingly rigid, reducing the flexibility of the garment.

Each of the closure solutions has advantages and disadvantages, and which is more appropriate usually depends on the application. Possible reversible closure solutions are buttons, clasps, patents, cords, lace, pull-locks, rubber bands, and Velcro. Their advantages and disadvantages are well known. The last two are the most important: the rubber is very flexible and fast to close; its reliability is guaranteed by its quality, and it will not fail if it is of good quality and well-tailored to the right size. Velcro also ensures very fast operation, although the closure must always be carefully positioned. Its advantage is that it can be used not only for point or in-line fastening, but also for fastening surfaces together in a demountable way. The disadvantage is that the hooked half can not only bind into the counterpiece, but also into all fabrics with a slightly looser structure. In addition, in some places it can be uncomfortable because the material is stiff and rough compared to clothing fabrics. A further disadvantage may be that the Velcro is thick, so that, for example, when stitching surfaces together, it increases the thickness of the stitched layers considerably. When using it, care should be taken to ensure that the edges are properly finished to prevent them from rubbing against the skin or abrading other parts of the garment. Unfortunately, no other solution that

connects surfaces in a detachable way can be recommended instead. Gluing and sewing are used to join surfaces in a reversible and non-detachable way. Sewing can, of course, usually be broken without leaving a trace, but if the joint is needed again, the joint must be re-established by sewing. Glue, on the other hand, cannot be dissolved without leaving a trace, and the glue residue can never be completely removed.

Relationship between protection aspects and clothing physiology

Clothing must protect the soldier from all possible external influences, at least as far as is reasonably possible for non-specialised protective clothing. However, these protective functions can only work if the soldier's body is covered by clothing. Unfortunately, protective functions and loose clothing that is comfortable in warm weather are contradictory requirements. The looser the soldier's clothing in warm weather, the less it can fulfil its protective function.

First of all, the clothing must protect the soldier from mechanical impact. Therefore, it is very important that the material of the garment, or at least the material of the outer layer of the garment, as well as the sewing thread and other fasteners used in the tailoring, have sufficient mechanical strength. The main components of mechanical strength are tensile strength and resistance to cutting, puncture, tearing and abrasion.

Also important are the surface properties of the garment material, such as surface unevenness and friction coefficient. If the surface is very uneven, it can be dangerous because it increases the chance of the fabric becoming caught on something. The surface friction coefficient determines the extent to which the fabric will adhere to other layers of clothing or other objects in the environment. Again, a middle ground is recommended in this respect. Neither a very sticky nor a very slippery surface is preferable: both can cause discomfort.

Soldiers often have to perform their duties in natural environments, where they have to deal with dangerous creatures. It is easier to fight enemies of

visible size, but harder to fight small ones or those that attack from below, such as parasites, insects, worms and snakes. Clothing should also provide protection against these. Protection against their intrusion is provided by both the sufficiently strong, dense and thick material of the clothing itself and by the appropriate design of the clothing. In this respect, the clothing must be as closed as possible to prevent these organisms from getting under the clothing. The clothing must therefore be closed at the wrists, ankles and neck. This tight closure is most important in hot weather, when these creatures are most active.

The soldier's clothing should also be resistant to chemicals. In terms of chemical resistance, some synthetic polymer fibres may be preferable to natural fibres, although they are also more expensive in terms of performance.

Soldiers are more likely to be exposed to the risk of fire during their activities. From this point of view, the behaviour of clothing worn directly on their body surface in the event of fire is a particular consideration. It would be best, of course, if the clothing material cannot catch fire or melt at all. However, special polymeric materials that meet this requirement are very unfavourable from a physiological point of view and are expensive. As the risk of fire is much lower for soldiers than for firefighters, for example, there is no justification for wearing clothing offering this level of protection on a permanent basis. What is worth considering, however, is that wearing clothing made directly from synthetic thermoplastic polymeric materials (e.g. polypropylene, polyamide, polyester) on the body surface may not only cause injury in the event of fire, but may also melt and cause fatal damage by melting into the skin. In this respect, natural materials, such as cotton, may ignite, but they cause less damage than melting polymeric materials. In this respect, it is better to wear cotton underwear.

Increasing UV radiation is a serious threat linked to climate change. Fortunately, the average garment already protects the skin from UV radiation, but this requires that the body surface is covered by a garment and that the soldier wears a hat to protect the head from the light. In this respect, too, it is essential that clothing is sufficiently closed.

Electricity can also pose a danger to the soldier. Fortunately, the materials normally used as clothing are electrically insulating. However, this electrical insulating ability is lost if the clothing becomes wet. The physiological advantage of clothing materials is that they can absorb water, but as we know, water conducts electricity, and so does wet clothing.

Synthetic raw materials can be problematic. Electrostatic charging is dangerous when flammable materials are present, which can ignite or explode due to the spark generated by electrostatic charging. It is therefore important that military clothing is not susceptible to static charging.

Unfortunately, meeting protection requirements is often not beneficial from a physiological point of view. Clothing that provides appropriate protection is not ventilated and loose enough in summer. It may be worth considering whether it is worthwhile to relax the protection requirements and thereby improve the physiological compliance of the garment.

Relationship between durability aspects and clothing physiology

Military clothing must also be reasonably durable. Durability is characterised by mechanical strength, resistance to abrasion, resistance to washing, colour fastness and resistance to heat, moisture, UV radiation and micro-organisms (e.g. fungi). It is also important for the soldier's safety that his clothing retains its original properties for a long time. The deterioration of these properties is caused by the wear and tear of everyday use and washing and, in particular, by ageing due to UV radiation, even without mechanical stress. Of course, the materials used make a difference. The better the quality of the material used, the later the deterioration will occur to the point where the garment is no longer usable. We have no control over wear and tear and the amount of UV radiation to which the garment is exposed, but we can choose a material that is more resistant to these stresses.

Durability can also be affected by the technology used to make the product. It is important to use the right quality, sufficiently strong, colourfast

sewing thread and the right sewing needle for the material and thread to be sewn. If the garment typically fails along the seams, the sewing technology should be reviewed.

Sewing technology can also affect durability and comfort in other ways. For example, if the trousers are reinforced with an extra layer of fabric in areas subject to high abrasion, such as the back of the leg between the legs and the front leg at the knee, the result may be mixed. The advantage is that the reinforced part is more resistant to stretching and therefore breaks down more slowly, the two layers will make the pilling that occurs under abrasive wear more likely to become apparent. On the other hand, the disadvantage is that the two layers make the seams very thick, which makes them much stiffer, much more prominent on the surface of the fabric and therefore more exposed to abrasion.

Unfortunately, meeting durability requirements is often not beneficial from a physiological point of view. Clothing that is sufficiently durable is not ventilated and loose enough in summer. It may be worth considering that by relaxing the durability requirements, the physiological compliance of clothing could be improved, which would of course mean that clothing would have to be changed more often. The question is: which is more important, the well-being of the soldier or the financial savings from less frequent changes of clothing?

Physiological functions of clothing

The physiological function of clothing is to create a micro-environment for the body in which it can maintain a constant temperature and the constant humidity of its immediate environment. To do this, clothing must provide adequate thermal insulation and ventilation of internal moisture and prevent the ingress of external moisture.

The human body is designed to keep its temperature constant with very little variation. In the process, it emits more or less vapour through the skin,

which is not normally detectable unless one is placed in a micro-environment that is impermeable to vapour (such as a raincoat made of polymer film). If the environment and the clothing provide a suitable micro-climate, the body can maintain its normal temperature at rest; it is neither cold nor hot, and its vapour emission is average and does not sweat.

In hot environments, when clothing cannot achieve the ideal ambient temperature, the body secretes sweat to cool itself. If there is no other way to cool the body, this sweat is necessary, otherwise the body would overheat.

The body produces more heat during movement than at rest, depending on the intensity of the movement. If this heat were to cause the body to overheat, the body would defend itself by sweating. This is not a problem in warm weather, when one would sweat even without exercise, but it can be a problem in temperatures when one would not sweat without exercise. The function of sweat is to remove excess heat by evaporation. However, this function cannot be adequately controlled by the body, because as the intensity of exercise decreases and the body reaches its normal temperature, the sweat that has not evaporated can cause the body to overheat. Therefore, and only in this case, it is necessary to wick the sweat from the body surface. In other cases, if the sweat is wicked from the surface of the body then it cannot do its job of cooling the body.

We usually feel comfortable wearing underwear that can absorb moisture and humidity. Such materials include cotton, linen, wool, natural silk and man-made fibres such as viscose, modal, lyocell, rayon, etc. Of the natural fibres, cotton is the most commonly used. The smooth surface of linen makes it suitable only for summer wear, but it is very good in summer. Wool is an excellent insulator and absorber. However, it is not recommended for direct wear on the body because, on the one hand, it requires special care to wash and clean and, on the other hand, many people cannot wear it directly on the body because the fibre ends irritate the skin and sting. Natural silk is also an excellent insulator and absorber, but its use is limited by the special care required and its high price. Cellulose-based man-made fibres, on the other hand, are, like cotton, excellent for underwear.

Clothing must also protect the body from precipitation. The problem with precipitation is that if one does not protect against it, it becomes absorbed into clothing. This both makes the clothing heavier and draws heat away from the body to evaporate, which leads to the body cooling down and becoming cold. This can be a problem even in hot weather, because too much moisture from precipitation can lead to overcooling of the body.

Overall, the physiological functions of clothing can be summarised in the following three points:

– heat resistance
– the ability to protect against precipitation
– sweat-wicking, vapour permeability (dry-fit)

Clothing in extreme cold weather

Extreme cold weather means that temperatures are consistently below –5°C. In extreme cold weather, the role of clothing is to maintain body temperature, keep the body warm, keep moisture from precipitation out of the clothing and wick any perspiration away from the body. The complication is that external conditions can vary due to changes in the intensity of the sun and air movement and the occurrence of some precipitation, and that the internal heat production and sweating of the soldier also varies greatly with changes in the intensity of movement. It must therefore be possible to control the clothing's ability to keep warm easily, to protect against precipitation and to wick sweat and perspiration on the move, within certain limits.

The insulation of clothing is not actually provided by the fibres of the garment, but by the air trapped in the structure of the garment, in the same way that the insulation of a double-glazed window is provided by the air trapped between the two layers of the window. The task is therefore to enclose as much air as possible in the structure of the garment, so that its insulating capacity can be increased without increasing the weight of the garment. Possibilities to enclose more air:

- To make the fabric from corrugated elementary fibres. Corrugated fibres create a loose, bulky fabric structure that traps a lot of air. Examples include soft woollen sweaters, but also polyester sweaters made from man-made fibres and loose, cotton-like fabrics used as linings for lightweight jackets.
- Another option is to use artificial fibres with a special cross-section. This cross-section may be hollow, for example, or one that results in a ribbed surface of the fibre, which prevents the fibres from fitting together over their entire surface. In case of fabrics made from such special fibres, more air will be present in the cavities and between the fibres.
- A further option is a hollow fabric structure, which can also be achieved by weaving or knitting. This can be thought of as placing spacer bars of sufficient density between two layers of woven or knitted fabric. In reality, these spacer bars are part of the fabric structure, but are made of fibres that retain their shape elastically and act like springs to ensure a constant distance between the two layers of fabric. This fabric structure can, of course, be used not only to increase thermal insulation but also, for example, to cushion collisions or even to create the possibility of more intensive air exchange. The cavities can even be filled with silicone oil to further cushion the consequences of impacts.
- The use of several layers of clothing can be a good solution, as there is more air between the layers. The particular advantage of this is that the number of layers can be easily varied, thus allowing the thermal insulation of the garment to be well controlled.

It is also important that these layers, which contain a lot of air, are sufficiently resistant to compression, because if they are compressed, they lose a significant part of their thermal insulation capacity. This can happen particularly in places where the garment is stretched over the body when worn, and such garments need to be designed to avoid stretching the garment and thus flattening the insulating layer.

However, sealed air must also be maintained there if insulation is the goal. Therefore, in parallel, an outer layer is needed that blocks intensive air

exchange; in other words, has poor breathability. This is particularly important if there is intense air movement in the external environment, namely, wind. This poorly breathable outer layer must, however, also allow sufficient ventilation of the body's own vapour and any sweat that may be generated. This is the structure of an amateur skier's garment, for example.

Controlling the insulating properties of winter clothing is an important task. Insulation can also be controlled by the number of layers of clothing worn. However, a more complex solution is not to vary the thickness of the insulating layer, but rather the breathability of the outer layer. If one is warm and increases the breathability of the outer layer, they allow a more intensive exchange of air trapped in the insulation layer and more intensive escape of condensation, but if one is cold they should reduce the breathability and prevent the exchange of air that has already warmed up. This control can be achieved by one or more thin, lightweight outer layers of clothing that are easy to take off and put on, made of a material that prevents air permeability and even has water-repellent properties. This solution makes it possible to avoid having to change the internal thermal insulation layers on the go.

Such an outer layer can be made of microfibre fabric, for example. Microfibres have much smaller pores than normal fibres due to the smaller than normal diameter of the fibres. It is important that the microfibre material itself is not absorbent. Smaller pores reduce breathability but do not eliminate it as a continuous waterproof layer, but water droplets cannot penetrate through the small pores from the outside, so the fabric wicks water away and lets out the vapour from the inside. Another advantage of microfibre fabrics is that they are light and flexible, easy to pick up or pack away when needed, and fit into small spaces.

During the manikin and live subject measurements, the back and arms were often cold. In this case, the solution may be to add a long-sleeved layer under the top layer. If the suit has a jacket, a warm lining should be added to the jacket, or the warm lining should be supplemented, but only to the back and upper sleeve (the outer part of the sleeve away from the body). The front should not be added because there is not only the silk lining in the front of the

jacket, but a stiffening linen lining is also added to this part when the front of the jacket is prepared. This makes the front thicker and therefore warmer.

The position of the head, hands and feet is specific in terms of thermal insulation. The body primarily seeks to keep the vital organs in the trunk at the right temperature. If the body's heating capacity decreases, it reduces the heating of less important peripheral areas such as the hands, feet and, for example, the ears and nose. It is therefore not enough that these parts of the body cool down more quickly than the rest of the body anyway, when one is cold the body reduces the heat supply to these parts of the body. It is therefore particularly important to keep these peripheral parts of the body warm. In sub-zero temperatures, soldiers should not wear general purpose boots. It is essential to have footwear specially designed for winter wear. There are boots insulated with polymer foam that protect the feet from cold. Good insulation is, for example, the fact that snow does not melt on such boots. If the physiological comfort of the soldier is important, the right footwear should be purchased. The same applies to gloves. It is not possible to perform delicate hand movements with frozen hands. Clever solutions have been devised to keep hands warm. For example, a basic five-fingered glove is used to make a mitten that can be folded over the fingers. When the soldier needs to use their fingers, they fold up the mitten part, and when they do not need it, they fold the second layer back on their fingers. One thing is for sure: keeping hands warm with five-fingered gloves is not possible. It is imperative that the fingers are held together and keep each other warm, and this is only possible with mittens.

No matter how well dressed a soldier is against the cold, if they have to be idle in the field for long periods in cold weather, they will need additional protection. If they do not have a tent and sleeping bag, it is worth considering carrying a warming blanket like those that paramedics use to cover cold patients. To my knowledge, this is a relatively thin, lightweight, but very warm blanket. At least one of these could be in a soldier's kit to improve their chances if they are stuck out in the field on a cold night.

A Gore-Tex membrane jacket is used to protect against precipitation. Gore-Tex membrane works in a similar way to microfibre fabric. Water droplets

cannot penetrate the small openings in the membrane, but the individual water molecules in the membrane can reach out and escape. The question is what the outer layer of the jacket is made of. This outer layer, which is in direct contact with the rain, must be made of a material that does not absorb or trap water. If this is not the case, the water trapped by the outer layer may cause the weight of the jacket to increase significantly, despite the fact that the jacket does not let water in. It might be worth trying a jacket and trousers made of microfibre fabric as a rainproof jacket and trousers. These would have the added benefit of keeping snow off them.

Sweat-wicking, vapour permeability, as mentioned earlier, is also important for winter clothing. The breathability of the outer layer of clothing should be controlled in the first instance. This regulates the air exchange and vapour permeability of the garment, as well as its insulating properties, and may even prevent the soldier from sweating at all. If perspiration does occur, it is advisable to wick the moisture away from the body surface, because if evaporation is inhibited then the cooling function cannot really be fulfilled. If, on the other hand, it remains on the surface of the body and cannot evaporate, it causes discomfort. There are two possibilities. One is to make sure that the underwear is absorbent and soaks up the sweat produced. In this case, however, the moisture stays close to the body surface and can cause the body to overcool if the temperature drops. The other option is to use two layers of underwear. The body-facing layer should be made of a fibrous material that does not absorb any moisture, such as polypropylene. This layer draws excess moisture away from the body and transfers it by capillary action to the layer of the garment away from the body, which absorbs and retains it. This moisture can no longer draw the heat required for evaporation away from the body. This solution can be found in many places and presumably also works for military clothing. However, I would like to point out once again that there is a risk that, in the event of fire, the thermoplastic polypropylene material in contact with the body surface could cause very serious injuries if it melts.

In extreme cold weather, there is no problem meeting the other requirements for clothing, except for ergonomic requirements, which were discussed earlier.

Clothing in extreme hot weather

Extremely hot weather is when the temperature is consistently above +30°C, i.e. when one is warm without clothes on.

In extreme heat, the situation is even more difficult than in extreme cold. Unfortunately, soldiers cannot afford not to wear clothes. They must wear their clothes, because only then can they fulfil the other functions listed above, in addition to the physiological requirements of clothing, in particular protection. Moreover, if clothing fulfils its protective function, it will be very detrimental from a physiological point of view. It is not possible to use loose, lightweight fabrics and open garments, although it would be particularly important to improve the ventilation of the garment.

From a physiological point of view, the role of clothing in extremely hot weather is to allow the body to dissipate heat as freely as possible. In such conditions, rain is a direct benefit, helping to cool the body. And sweat is also there to cool the body, so in my opinion it is a mistake to drain sweat from the body surface. In fact, wetting should be intentionally aided. In hot weather, it can help a lot if we wet our hair, our sun hats, perhaps other clothing, spray water on our face and other exposed skin, because all of this can help to cool our bodies.

In hot weather, it is advisable to wear clothing made of breathable, absorbent fabrics. Wherever possible, the soldier's clothing should be made of the thinnest possible fabric, for example panama, and as loose-fitting as possible. Loose clothing helps ventilation and evaporation of sweat, thus cooling the body.

This could possibly be improved by using mesh-like ventilated inserts in more vulnerable areas of the garment, such as the upper sides and the sleeve, but this would also reduce the protective capacity. The ventilation of the cap can be improved by adding as many ventilation slots as possible. It must also be possible to prevent sweat from dripping into the soldier's eyes, which would temporarily impair their vision, and this cannot be allowed. If the hat does not prevent this and the soldier's hands are constantly occupied, a good solution is to use a headband to absorb sweat from the forehead. Perhaps

summer trousers can be made, the leg of which can be unzipped and thus temporarily converted into shorts. This would allow the soldier to loosen up their clothing whenever possible.

Clothing made of linen is recommended, as linen is even preferable to cotton, especially in hot weather. It is very strong, absorbent and heat-wicking. It is also an excellent bedding material.

The loose, airy inner structure of the hollow fabric also allows sweat to evaporate and vapour to escape. This can be particularly advantageous if, for example, a soldier has to put on a ceramic Kevlar bullet and shrapnel proof vest in the summer heat. It is not necessary to go into details on the physiological discomfort of this vest. If, however, the soldier were to wear under the vest an undergarment made of hollow fabric, it would greatly improve the soldier's well-being by improving the ventilation of the garment. In addition, it would also be advantageous to wear them because they would help to distribute the impact of a projectile over a larger area in the event of a hit.

A soldier cannot go without boots even in summer. In summer, feet inevitably sweat when wearing closed shoes. Discomfort can be reduced somewhat by using silver-plated socks. The beneficial antiseptic properties of silver have been known since antiquity. Silver can be applied to textile fibres in such a way that it does not come off even after frequent washing. When used in socks, it prevents foot odour caused by the decomposition of fungi by preventing them from colonising.

The properties of textiles can be modified significantly by finishing. Thus, by curing, textiles can be made oil and soil repellent, easier to remove dirt from during cleaning, less wrinkly and softer to the touch.

The use of a T-shirt made of synthetic fibres, available in sports shops, instead of a cotton T-shirt has been raised. There are also a number of innovations in this area that could be beneficial. However, I can only write my own opinion on this matter. As I have already mentioned, sweat should not be drained off, but the opportunity should be created for the sweat to evaporate and the vapour to escape. The dangers of clothing made of synthetic materials have already been mentioned. There is a greater risk of fire in summer.

In the event of a fire, if the soldier is wearing only this one shirt, the fire can immediately reach it. From a fire point of view, a synthetic T-shirt is much more dangerous than a cotton T-shirt because of the melting of the material. In extremely hot weather, a thin, loose linen shirt may be recommended instead of a cotton T-shirt.

When it comes to clothing for extreme hot weather, it is particularly important to make the right compromises. As much as the protective capacity of the clothing is compromised, the clothing can be better from a physiological point of view. Where to draw the line is a big decision.

Summary

There are many ways to improve comfort. In many cases, they are a matter of mindfulness or determination, but in others they are also, to a lesser or greater extent, a matter of money. The study does not address new options such as solar heated/coolable clothing, gloves, shoes, or special high-strength, heat and flame resistant materials, or aerogels, the insulating material used in the clothing of astronauts and polar explorers, which are probably not financially feasible at present.

The literature describes a number of new options that could help soldiers to adapt to extreme weather conditions in the future. This adaptation is particularly difficult when it is necessary to adapt to changes in climatic conditions within a short period of time, without the possibility of changing clothes. It seems that research will also be able to provide solutions for these cases.

In the foregoing, we have proposed solutions that can be applied in the current circumstances and with more modest financial means, and can improve the wearability of military clothing. However, it is also important to note that we all differ in our sense of comfort. We therefore believe that soldiers must be allowed to adjust their clothing to their individual needs, invisibly underneath the prescribed clothing, so that they can ensure a proper level of comfort.

Summary

What used to be the talk of the town at research institute conferences is now a reality. Conflicts over potable water are breaking out in more and more parts of the world, and more and more people are dying violent deaths in the fight for water resources. While until the turn of the Millennium, the number of water conflicts reported each year was less than half a dozen, in the last 10 years it has exceeded that number every year. In 2012 alone, 19 cases of violence over freshwater were recorded.[236]

We are also seeing the first fault lines in freshwater ownership between countries we never imagined. A good example is the situation in the United States and Canada. Some areas of the former are thirsty, while the latter has an abundance of fresh water. The issue of the possible use of Canadian freshwater resources by the southern neighbour is now a daily topic in relations between the two countries. Neither the Canadian public nor the mainstream political forces are enthusiastic when these ideas are discussed.

In Hungary, this problem does not yet exist in this form. At the same time, our country is highly vulnerable when it comes to freshwater due to its geographical location. Our major rivers come from outside the border, so we do not primarily manage them. Cooperation with neighbouring countries is good, but we have not been able to reach a satisfactory solution to the issues of the Bős power plant and cyanide pollution. Both show that we do not have unrestricted control over our flowing freshwater. In a crisis situation, we depend on the goodwill of others, and let there be no doubt: if it comes to a decision to reduce water consumption because of limited access for whatever reason, every government will have its own country in mind. Preparations must therefore begin to address the situation, to avoid a repetition of the above examples.

[236] Fant et al. 2016.

It is worth recalling David Attenborough's thoughts, not without some irritation, to the participants at the COP26 conference in Glasgow:

> "The richest nations have 'a moral responsibility' to help the world's poorest. And it would be 'really catastrophic' if we ignored their problems. Every day that goes by in which we don't do something about it is a day wasted. And things are being made worse. Global security and stability could collapse, and migration crises and food shortages could lead to conflict and chaos if countries do not tackle greenhouse gas emissions. And the Climate Transparency Report warns that carbon emissions are rising rapidly in the world's 20 richest countries. The world is now 1.1 degrees Celsius warmer than in the pre-industrial era and preventing further temperature rises is a huge challenge."[237]

When sorting the challenges, the following nodes are worth paying close attention to:[238]

Challenges in water safety:

- *Sea level rise due to climate change:* sea level rise and subsequent salinization and storm risks; sharply rising tides and flooding affecting coastal water bases; increased social and political unrest.
- *Changes in rainfall distribution due to climate change:* increased risk of drought or extreme rainfall distributions;[239] all of which make access to freshwater more difficult due to reduced water availability; all of which affect security, and thus social, political or economic outcomes.[240]
- *Climate change-induced disasters disrupt sanitation systems:* more frequent and intense disasters that disrupt or reduce freshwater supplies for

[237] Shukman 2021.

[238] IMCCS 2021.

[239] In Hungary, the high spatial and temporal variability of precipitation has been a feature of the past, but this has increased in recent decades. Over the last century, the national annual precipitation has not decreased significantly, but its distribution has become more extreme, affecting the quantity and quality of water resources and calling for the expansion of water management based on water conservation (see InfoRádió 2020).

[240] European Environment Agency 2017.

sanitation purposes and impact health and social security, particularly in densely populated areas.

Challenges in food safety:

– *Weather-related disruptions in agriculture:* the frequency and intensity of extreme weather events are also increasing, leading to crop failure and affecting the price and availability of basic foodstuffs.[241]
– *Local food supply disruptions have an impact on national, regional and global markets:* unexpected and significant increases in the price of basic foodstuffs affect the supply chain, causing economic and social uncertainty.

Challenges in health security:

– *Climate change contributes to the faster spread of infectious diseases:* in particular, rising temperatures can accelerate the spread of infections, increasing the number of illnesses and deaths.
– *Extreme heat associated with climate change:* rising temperatures and humidity can cause heat stroke and organ damage.[242]
– *Climate change will significantly increase the workload on health institutions:* more frequent and severe disasters will increase the workload on health infrastructure; mass infections will become more frequent; all of which will make access to health care more difficult, thus increasing the number of deaths and worsening the well-being of society.[243]

[241] Climate change is not only affecting land-based food sources. The distribution of some fish stocks in the Northeast Atlantic has already changed, affecting the communities that rely on these stocks throughout the supply chain (European Defence Agency 2021).

[242] In the summer of 2017, the "Lucifer heatwave" brought record high temperatures of over 40°C to southern regions of Europe, from the Iberian Peninsula through the Balkans to Turkey. The scorching heat has caused several deaths, as well as crop-damaging droughts and forest fires (European Defence Agency 2021).

[243] Climate change poses increasing challenges for the domestic health sector: the emergence of new diseases, changes in patient patterns, an increase in patient flows, especially in emergency cases, and the potential threats to health care institutions' ability to function and the health of health care workers due to climate change and extreme weather events (Antal et al. 2020).

The challenges facing the ecosystem:

– *Climate change is increasing both the number and intensity of natural disasters:* simultaneous or rapid succession of disasters significantly reduces the effectiveness of response capacity, increasing the potential for social and political discontent. It is worth looking at the loss of human life caused by the 10 most destructive natural disasters (Annex II, Tables A1–A2).
– *Climate change is reducing biodiversity:* this is leading to the disappearance of species, along with the emergence of invasive species, with consequences such as disruptions to food and drinking water supplies, reduced agricultural production efficiency and increased competition for resources.[244]
– *Climate change is also disrupting the oceans:* some marine species are disappearing and some are migrating[245] disrupting the marine ecosystem, affecting the security of human supply and increasing competition for resources.

Economic challenges:

– *Disruptions caused by weather variability have a direct impact on the local, regional and global economy:* the greatest risk is that they will affect food, water and energy supply systems, disrupting economic security at all levels (Annex II, Tables A1–A2). Economic losses have increased sevenfold from the 1970s to the 2010s, from an average of 49 million USD to 383 million USD per day worldwide. The most common cause is wind storms, which cause the largest economic losses worldwide.

[244] With climate change, several new invasive pests and pathogens have appeared and spread rapidly in our country. With warming temperatures, more pests and invasive species are expected to appear. An example of this danger is the mass increase and spread of *Lymantria dispar,* which caused damage to 212,000 hectares in 2005. But equally serious problems are caused by the damage caused by *Rhagoletis completa* and *Nezara viridula* (see *Engie* 2020).

[245] As the Mediterranean warms, marine species are migrating 10 metres deeper into colder waters to ensure their survival. Researchers at Tel Aviv University have analysed 236 species. On average, fish, crustaceans and molluscs are moving 55 metres deeper. For the future, policy makers and the economy must prepare for both deeper and more distant migrations of species (Chaikin et al. 2021: 75–88).

– *Climate disruptions increase economic and social inequalities:* climate disruptions have the greatest impact on the most vulnerable communities, increasing the proportion of unemployed and poor people and the gap between richer and poorer communities.

Challenges to infrastructure security:
– *Extreme weather and sea level rises threaten critical civil infrastructure:* affecting the security of energy networks, manufacturing capacity, communications, health networks, financial infrastructure, agriculture and water utilities.
– *Climate change is affecting water transport routes:* warming oceans are affecting optimal maritime transport and military routes, changing the conditions for international trade and global security.[246]

Challenges to national security:
– *Repetitive stresses caused by climate change in densely populated areas:* including sea level rise, floods and droughts, extreme heat, which threaten people living and working in large cities and financial and economic centres.
– *The effects of climate change are intensifying forced displacement and migration:* the proportion of uninhabited and uninhabitable areas is increasing, with the associated disruption to individual livelihoods; coastal regions and islands are particularly vulnerable.[247]
– *Climate change crises also affect governance:* climate change stress can lead to increased social, economic and political instability, which can increase political divisions, corruption or weaken civil liberties within a country.

[246] The hesitant attempts to control the routes following the opening of the Northwest Passage and the Northern Trade Route are a good illustration of the uncertainty.

[247] Tuvalu is a small oceanic state that will be displaced by sea level rise in the foreseeable future. "We're sinking like everyone else. And it doesn't matter whether we feel the impact today, like we are here in Tuvalu, or in a hundred years, one day we will all feel the severe consequences of this global crisis," said one of the country's leaders in 2021 (Bobák 2021).

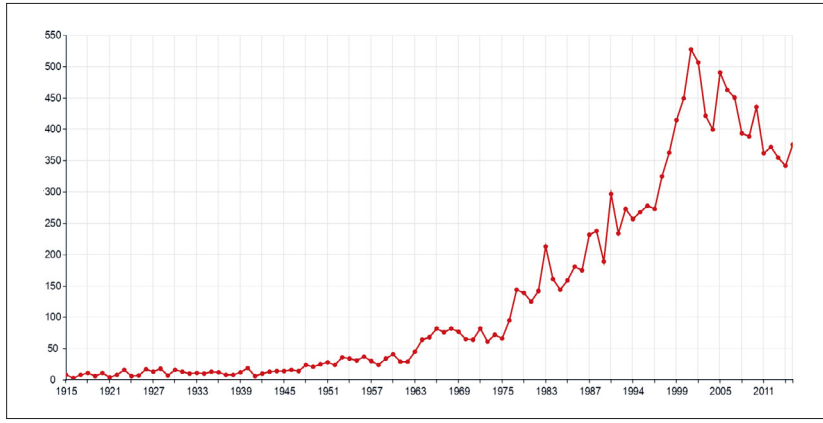

Figure 21. *Number of natural disasters between 1915 and 2015*
Source: Reis 2018: 76

Challenges to military security:

– *Threats to military infrastructure:* changes in the frequency and intensity of disasters (Figures 21–22), sea level rise, extreme weather affect the operational capability of military installations; increased military involvement in disaster prevention and recovery also means increased workload, diverting resources from other military tasks.
– *The military challenges associated with climate change:* which also have an impact on alliance systems, affecting their operational effectiveness and capabilities, while consideration must be given to increasing the proportion of dual-use troops and assets (both conventional and humanitarian) to facilitate a more effective response.
– *Potential failure of military responses to the challenges of climate change:* effective military responses to challenges in civilian environments that carry significant risks and whose failure will affect trust in military power.[248]

[248] The role of civil–military interoperability will be enhanced, ensuring more efficient work from the preparatory phase, economical use of parallel capacities and avoiding rivalry (for more details see European External Action Service 2019).

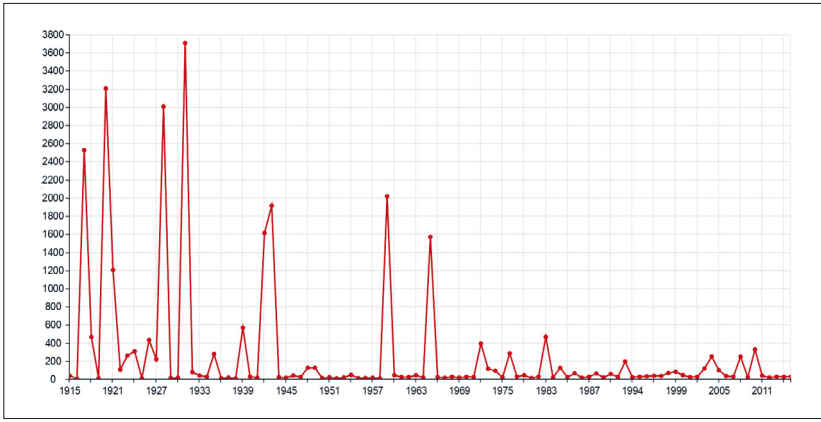

Figure 22. *Number of people killed in natural disasters (thousand people) between 1915 and 2015*
Source: Reis 2018: 76

It should also be borne in mind that the intensity and content of military involvement in disaster prevention and recovery is not uniform and varies over time (Figure 23).

International security:

- *Climate change increases the likelihood of tensions or conflicts between nations:* this is particularly dangerous in areas such as disruptions to food, water and energy systems, which increase the likelihood of tensions or conflicts between nations.
- *The effects of climate change may challenge existing peace and security agreements, treaties and institutions:* this is due to food, water and energy security disruptions exacerbated by climate change, which may directly lead to a deterioration of the situation; and along the same lines, it may challenge agreements such as water sharing, defence agreements, ceasefire agreements, and put institutions such as the UN or other regional organisations in crisis.
- *Changes in alliances and the balance of power due to climate change:* disruption of previous alliance agreements and the established balance of power due to geostrategic changes caused by climate change.

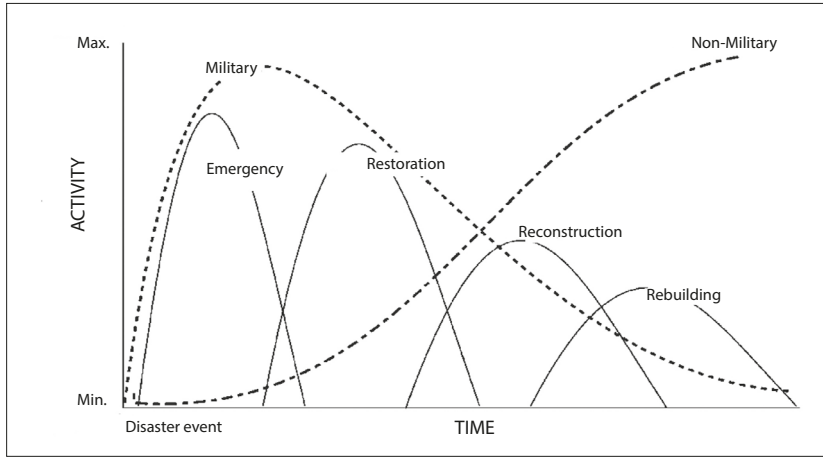

Figure 23. *Generic timeline of disaster response phases*
Source: Reis 2018: 78

– *Isolation at both regional and international level due to climate change-induced security disruptions:* this could lead nations to withdraw from regional and international security institutions and increase tensions within the group.

Novel security challenges:
– *Unilateral expert engineering efforts to slow or reverse climate change:* unilateral, uncoordinated national and expert efforts carry risks that could trigger unpredictable processes, posing a serious security risk.
– *Abuse of climate change technologies and data:* the risk of using climate change technologies and data (energy consumption monitoring, privatisation of weather data), which could lead to increased and uncontrolled monitoring of the population.
– *Secondary impacts caused by a series of catastrophic events:* those with unforeseen, even global consequences in the atmosphere, ecosystem or ice sheet extent.
– *Unanticipated impacts and risks:* unexpected and sudden climatic disturbances that pose significant safety risks.

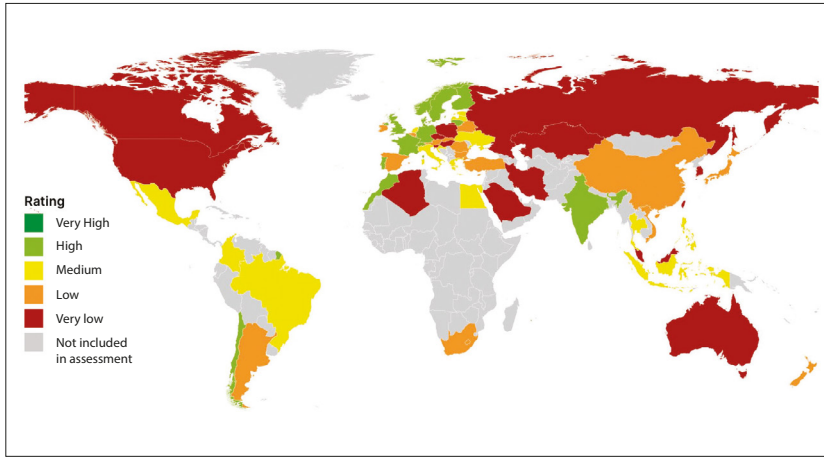

Figure 24. *Climate protection index for the largest emitters*
Source: Burck et al. 2020

We were hopeful that by the completion of this book, significant progress would have been made at the 26th UN Conference on Climate Change in Glasgow (COP26) to address the causes of climate change. Initial assessments are cautiously optimistic, but many have also expressed a sense of shortcomings. In an interview, climate scientist Diána Ürge-Vorsatz, professor at CEU and vice-chair of the UN Intergovernmental Panel on Climate Change (IPCC) Working Group III, pointed out several contradictions.[249]

She stressed that it is difficult to give precise figures because of the many uncertainties, but that it is better to look at trends:[250]

– If we do nothing compared to today, we will reach 2.7°C by the end of the century.
– If we meet our 2030 commitments, it will be 2.4°C.
  • if we add to these the long-term net zero targets of 2.1°C
  • if we add those that have been announced but not yet officially documented, we get to 1.8°C, which is still far from 1.5°C

[249] Németh 2021.
[250] Németh 2021.

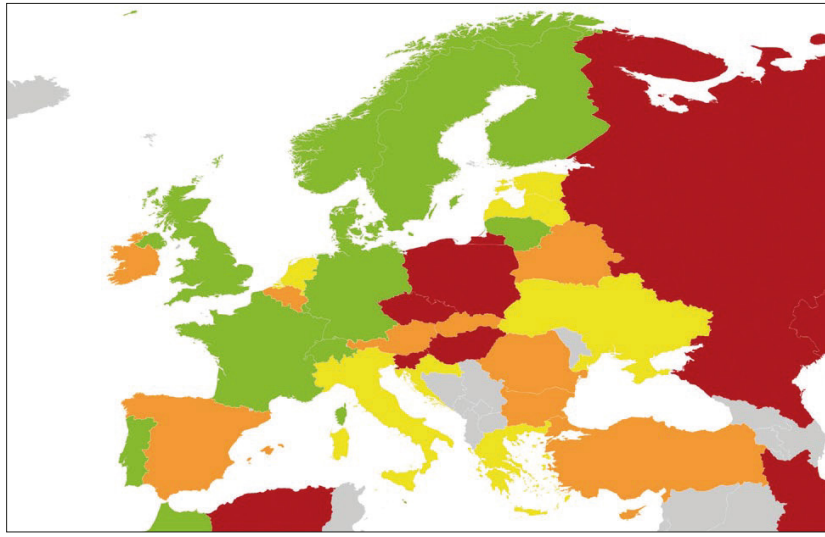

Figure 25. *Climate protection index in Europe for the largest emitters (green: very good; red: very poor)*
Source: Burck et al. 2020

We may also feel a sense of lack that the text on the phasing out of coal-based energy production (an important milestone) has been softened, and in the final version the word 'phasing out' has been replaced by 'reducing', and there is no mention of oil and gas. One reason for this may be that richer countries benefit from the omission of oil and gas, as it is mainly developing countries that have difficulties in reducing their coal use. A further contradiction is that no clear end to subsidies for fossil energy production has been set, only 'inefficient' subsidies are being phased out. However, for all its flaws, it is the first document to mention fossil fuels and their subsidies at all (Figures 24–25).

The results achieved are also worth highlighting:

– The Paris Climate Agreement Rulebook has been agreed. The debate on carbon markets has been going on for years.

- India has pledged to be carbon neutral by 2070 (i.e. greenhouse gas emissions and removals will be in balance and the total carbon footprint will be virtually zero).
- Several countries have committed to a 30% reduction in methane emissions, which are more harmful than carbon dioxide.
- More financial resources are being provided to developing countries to help them adapt, but overall little progress has been made in the financial area.
- There are also commitments to promote electric transport and to reduce deforestation.
- The issue of 'greenwashing' was a major point of discussion, and some of the loopholes that allowed this have been closed.

Overall, therefore, no breakthroughs were achieved, only partial results. Although the direction is good, we will have to live with the problem of climate change for a long time to come, so we must remain vigilant about its impact on national security. Not just for the military.

References

Government Decree 201/2001 (X. 25.) on drinking water quality requirements and monitoring arrangements. Online: https://net.jogtar.hu/jogszabaly?docid=a0100201.kor

Government Decree 44/2003 (IV. 3.) on the promulgation of the Agreement between the Government of the Republic of Hungary, the Government of Romania, the Government of the Slovak Republic and the Government of Ukraine on the establishment of a multinational technical battalion, signed in Budapest on 18 January 2002. Online: https://net.jogtar.hu/jogszabaly?docid=A0300044.KOR

Government Resolution 1163/2020 (IV. 21.) on Hungary's National Security Strategy. Online: https://honvedelem.hu/hirek/government-resolution-1163-2020-21st-april.html

Government Resolution 1393/2021 (VI. 24.) on the National Military Strategy of Hungary. Online: https://defence.hu/news/national-military-strategy-of-hungary.html

National Assembly Resolution 29/2008 (III. 20.) on the National Strategy on Climate Change

National Assembly Resolution 23/2018 (X. 31.) on the second National Climate Change Strategy 2018–2030 with an outlook for 2050

Abelovszky Tamás (2015): Megmutatjuk a legnépszerűbb migrációs útvonalakat. *DiploMaci,* 13 November 2015. Online: https://diplomaci.blog.hu/2015/11/13/megmutatjuk_a_legnepszerubb_migracios_utvonalakat

AEPI (2009): *Sustain the Mission Project: Casualty Factors for Fuel and Water Resupply Convoys. Final Technical Report.* Online: https://apps.dtic.mil/sti/pdfs/ADB356341.pdf

Amelang, Sören (2019): German Army Exits Hard Coal Heating. *Clean Energy Wire,* 09 August 2019. Online: https://www.cleanenergywire.org/news/german-army-exits-hard-coal-heating

Antal Ferenc (2022): A Magyar Honvédség feladata az ország fegyveres védelme. *Honvedelem.hu,* 03 August 2022. Online: https://honvedelem.hu/hirek/a-magyar-honvedseg-feladata-az-orszag-fegyveres-vedelme.html

Antal Z. László – Ferencz Zoltán – Páldy Anna eds. (2020): *Éghajlatváltozás és egészség* [Climate Change and Health]. *Report*. Budapest: Társadalomtudományi Kutatóközpont. Online: https://tk.hu/uploads/files/2020/eghajlatvaltozas_egeeszseg_jelentes.pdf

Australian Government Department of Defence (2013): *Defence White Paper 2013*. Online: www.files.ethz.ch/isn/172498/Australia%20defense%20WP_2013_web.pdf

Australian Government Department of Defence (2023): *Disaster Relief & Humanitarian Assistance*. Online: https://news.defence.gov.au/topic/disaster-relief-humanitarian-assistance

Australian Security Leaders Climate Group (2021): *Whole-of-Nation Climate-Security Risk Assessment. Missing in Action.* Online: https://www.aslcg.org/wp-content/uploads/2021/09/ASLCG_MIA_Report.pdf

Baobab News (2023): *Major Routes of Migration in Africa.* Online: https://africa.baobab.news/major-routes-of-migration-in-africa/?noamp=mobile

Barbarics, Tamás – Padányi, József (2013): Possibilities of Using Renewable Energies in Military Bases at Home and Abroad. In Pérez Donsión, Manuel (ed.): *International Conference on Renewable Energies and Power Quality (ICREPQ'13).* Vigo: European Association for the Development of Renewable Energies, Environment and Power Quality (EA4EPQ). Paper: BT_3, 3.

Barrie, Chris (2013): Why the Defence Force Must Plan for Climate Change. *ABC News,* 12 September 2013. Online: https://ab.co/3bFdYps

Bede Márton (2020): Elfogyott a víz a mexikói–amerikai határon. *444,* 24 October 2020. Online: https://444.hu/2020/10/24/ELFOGYOTT-A-VIZ-A-MEXIKOI-AMERIKAI-HATARON

Bedi, Rahul (2020): Why Army Shuns Local High-altitude Clothing. *The Tribune,* 20 October 2020. Online: https://www.tribuneindia.com/news/comment/why-army-shuns-local-high-altitude-clothing-158278

Beeler, Carolyn (2017): Who Controls the Northwest Passage? It's Up for Debate. *The World,* 04 September 2017. Online: https://theworld.org/stories/2017-09-04/who-controls-northwest-passage-its-debate

Bender, Jeremy (2015): Russia Just Put the Finishing Touches on 6 Arctic Military Bases. *Insider,* 07 December 2015. Online: https://www.businessinsider.com/russia-equipped-six-military-bases-in-the-arctic-2015-12

Berek Tamás (2015): A víz, mint környezeti erőforrás a Kárpát-medencében, vízbázisok, vízbiztonság. In Csengeri János – Krajnc Zoltán (eds.): *A hadtudomány és a hadviselés komplexitása a XXI. században.* Budapest: Nemzeti Közszolgálati Egyetem, 61–73.

Bhaskar, Utpal (2018): Narendra Modi Inaugurates Kishanganga Hydropower Project in Kashmir. *Mint,* 19 May 2018. Online: https://www.livemint.com/Politics/1d6mcw40PoymB4h2g40GiK/Narendra-Modi-inaugurates-Kishanganga-hydropower-project-in.html

Bhattacharyya, Arpita – Werz, Michael (2012): Climate Change, Migration and Conflict in South Asia. *CAP* [Center for American Progress], 03 December 2012. Online: www.americanprogress.org/issues/security/report/2012/12/03/46382/climate-change-migration-and-conflict-in-south-asia

Bobák Zsófia (2021): Modern kori Atlantisszá válhat egy óceániai állam, ahol arra készülnek, hogy teljesen elnyeli őket a víz. *Rakéta,* 09 November 2021. Online: https://raketa.hu/modern-kori-atlantissza-valhat-egy-oceaniai-allam-ahol-arra-keszulnek-hogy-teljesen-elnyeli-oket-a-viz

Bozzay Balázs (2021): Módosította az időjárást Kína a kommunista párt 100. születésnapján tartott tömegrendezvények előtt. *Telex,* 05 December 2021. Online: https://telex.hu/kulfold/2021/12/05/kina-modosit-idojaras-tomegrendezveny-kommunista-part-szuletesnapja

Brissenden, Michael (2013): Climate Change a "Threat Multiplier" for Defence. *ABC News,* 24 March 2013. Online: https://ab.co/3NG9Bb3

Brown, Oli – Dimsdale, Taylor (2021): Climate Risk Management for International Organizations. *E3G,* 28 June 2021. Online: https://www.e3g.org/publications/climate-risk-management-for-international-organizations/

Bryant, Elizabeth (2015): In Paris, Top Officials Warn Climate Change Poses Major Security Threat. *Deutsche Welle,* 15 October 2015. Online: https://www.dw.com/en/in-paris-top-officials-warn-climate-change-poses-major-security-threat/a-18784110

Bundeswehr [s. a.]: *Internationale Katastrophenhilfe der Bundeswehr.* Online: https://www.bundeswehr.de/de/ueber-die-bundeswehr/auftrag-aufgaben-bundeswehr/internationale-katastrophenhilfe-bundeswehr

Burck, Jan – Hagen, Ursula – Bals, Christoph – Höhne, Niklas – Nascimento, Leonardo (2020): *The Climate Change Performance Index* (7 December 2020). Online: https://newclimate.org/2020/12/07/the-climate-change-performance-index-2021

Cambridge Climate Lecture Series (2018): *Talking Climate Solutions with Professor Schellnhuber: "It Is the Nonlinearity Stupid!".* Online: https://climateseries.com/news/29-schellnhuber-cop24

Carrington, Damian (2013): Climate Change Poses Grave Threat to Security, Says UK Envoy. *The Guardian*, 30 June 2013. Online: http://www.theguardian.com/environment/2013/jun/30/climate-change-security-threat-envoy

CCS Earth Institute (2008): Climate Change May Challenge National Security, Classified Report Warns. *Columbia Climate School The Earth Institute News,* 07 February 2008. Online: www.earth.columbia.edu/articles/view/2202

Chaikin, Shahar – Dubiner, Shahar – Belmaker, Jonathan (2021): Cold-water Species Deepen to Escape Warm Water Temperatures. *Global Ecology and Biogeography,* 31(1), 75–88. Online: https://doi.org/10.1111/geb.13414

Chamandy, Aidan (2021): Military Will Likely Need Help for Natural-Disaster Missions: DND. *iPolitics,* 06 August 2021. Online: https://ipolitics.ca/2021/08/06/military-will-likely-need-help-for-natural-disaster-missions-dnd

Choi, David (2021): Climate Change Could Make "Military Equipment Useless," Experts Warn. *Military.com,* 10 September 2021. Online: https://www.military.com/daily-news/2021/09/10/climate-change-could-make-military-equipment-useless-experts-warn.html

Chossudovsky, Michel (2004): The Ultimate Weapon of Mass Destruction. "Owning the Weather" for Military Use. *Global Research,* 27 September 2004. Online: http://www.globalresearch.ca/articles/CHO409F.html

Climate Central (2018): *Military Bases of Warming.* Online: https://medialibrary.climatecentral.org/resources/military-bases-of-warming

ClimeNews (2021): The Relationship Between the Military and the Oil Industry in a Collapsing Climate. *ClimeNews,* 27 October 2021. Online: https://climenews.com/A-HADSEREG-ES-AZ-OLAJIPAR-KAPCSOLATA-AZ-EGHAJLAT-OSSZEOMLASABAN

CNA (2007): *National Security and the Threat of Climate Change.* Online: www.cna.org/cna_files/pdf/national%20security%20and%20the%20threat%20of%20climate%20change.pdf

Contact Magazine (2017): Tibet Water Source for Asia. *Contact,* 19 June 2017. Online: www.contactmagazine.net/articles/china-deploys-new-tank-tibet/attachment/tibet-water-source-for-asia

COP26 (2021a): Climate Change is a Threat to Our Security – Boris Johnson. *BBC News,* 23 February 2021. Online: https://bbc.in/3AsIsWj

COP26 (2021b): Boris Johnson: Climate Change about Jobs Not "Bunny Hugging". *BBC News,* 22 April 2021. Online: https://bbc.in/3OMqr9I

COP26 (2021c): "You Might as Well Bomb Us," Says President of Palau. *The Guardian,* 02 November 2021. Online: https://www.theguardian.com/world/video/2021/nov/02/cop26-you-might-as-well-bomb-us-says-president-of-palau-video

Council of the European Union (2018): *Council Conclusions on Climate Diplomacy* (26 February 2018). Online: http://euromil.org/wp-content/uploads/2021/03/18_Council_conclusions_climate_diplomacy.pdf

Cox, Kate – Knack, Anna – Robson, Martin – Adger, Neil – Paillé, Pauline – Freeman, Jon – Black, James – Harris, Ruth (2020): *A Changing Climate. Exploring the Implications of Climate Change for UK Defence and Security.* Santa Monica, CA – Cambridge, UK: RAND Corporation. Online: https://doi.org/10.7249/RRA487-1

Defense Aerospace (2020): First Defence-Energy Project Developed in Consultation Forum Receives EU Funding. *Defense-Aerospace.com,* 23 January 2020. Online: https://www.defense-aerospace.com/articles-view/release/3/209123/first-defence_energy-project-receives-eu-funding.html

Dickson, Amanda (2021): Opinion: Why the Military Cares about Climate Change. *KSL NewsRadio,* 23 April 2021. Online: https://kslnewsradio.com/1947362/climate-change-why-the-military-cares-about

Draveczki-Ury Ádám (2014): 18,2 millió liter víz, 2 millió kilométer, 723 katona, 166 technikai eszköz [18.2 Million Litres of Water, 2 Million Kilometres, 723 Soldiers, 166 Technical Equipment]. *Honvedelem.hu,* 24 January 2014. Online: https://honvedelem.hu/hirek/hazai-hirek/18-2-millio-liter-viz-2-millio-kilometer-723-katona-166-technikai-eszkoz.html

Dumont, Marie – Shapiro, Ariel – Therrien-Tremblay, Anne-Marie (2021): The Canadian Armed Forces Responding to Domestic Emergencies: Some Implications. *HillNotes,* 13 December 2021. Online: https://hillnotes.ca/2021/12/13/the-canadian-armed-forces-responding-to-domestic-emergencies-some-implications

Earth Overshoot Day (2023): Past Earth Overshoot Days. Online: https://www.overshootday.org/newsroom/past-earth-overshoot-days

Efron, Shira et al. (2021): The Implications of Climate Change for Military Intelligence. *INSS Insight,* (22 November 2021), 1532. Online: https://www.inss.org.il/publication/climate-change-and-intelligence

Else, Liz (2019): Want to Stop Climate Change? Jared Diamond Says Nations Need Therapy. *NewScientist,* 05 June 2019. Online: www.newscientist.com/article/mg24232332-900-want-to-stop-climate-change-jared-diamond-says-nations-need-therapy

Energiabiztonsági kerekasztal a NATO-ban (2021). Brussels, 13 December 2021 Ministry of Foreign Affairs and Trade, Permanent Representation of Hungary to NATO. Manuscript.

Engie (2020): Klímaváltozás a mezőgazdaságban. *Engie,* 30 December 2020. Online: https://engie.hu/engie-magyarorszag-hirek-klimavaltozas-a-mezogazdasagban

Erdei István (2010): A Jordán-folyó, mint a vízkonfliktusos területek tipikus példája. *Mediterráneum,* 4(2), 2–9. Online: http://epa.oszk.hu/02000/02090/00012/pdf/EPA02090_Mediterran_Balkan_Forum_2010_04_02_01-09.pdf

European Defence Agency (2012): *Military Green: Energy and Environment at the EDA*. Online: http://euromil.org/wp-content/uploads/2021/03/13_EDA_military-green-leaflet.pdf

European Defence Agency (2021a): *A mezőgazdaság és az éghajlatváltozás*. Online: https://www.eea.europa.eu/hu/jelzesek/jelzesek-2015/cikkek/a-mezogazdasag-es-az-eghajlatvaltozas

European Defence Agency (2021b): *Éghajlatváltozás és víz – melegedő óceánok, árvizek és aszályok*. Online: https://www.eea.europa.eu/hu/jelzesek/eea-jelzesek-2018-viz-elet/cikkek/eghajlatvaltozas-es-viz-2013-melegedo

European Environment Agency (2017): *Climate Change, Impacts and Vulnerability in Europe 2016. An Indicator-based Report*. Online: www.eea.europa.eu/publications/climate-change-impacts-and-vulnerability-2016

European External Action Service (2019): *EU Concept on Effective Civilian–Military Coordination in Support of Humanitarian Assistance and Disaster Relief.* Online: https://data.consilium.europa.eu/doc/document/ST-5536-2019-INIT/en/pdf

European Organisation of Military Associations and Trade Unions [s. a.]: *Armed Forces & Climate Emergency.* Online: http://euromil.org/armed-forces-climate-emergency

Falconer, Rebecca (2021): Study: 10 Biggest Climate Disasters of 2021 Cost $170 Billion. *Axios,* 27 December 2021. Online: www.axios.com/climate-disasters-cost-world-billions-2021-study-6bdb1eb0-faf4-4e05-8915-b2a7374270cf.html

Fant, Charles – Schlosser, C. Adam – Gao, Xiang – Strzepek, Kenneth – Reilly, John (2016): Projections of Water Stress Based on an Ensemble of Socioeconomic Growth and Climate Change Scenarios: A Case Study in Asia. *PLoS ONE,* 11(3). Online: https://doi.org/10.1371/journal.pone.0150633

Federal Ministry of Defence (2021): *Key Elements of the Bundeswehr of the Future*. Online: https://www.bmvg.de/resource/blob/5092636/f30cf5dd345488be5c5a090c58367fae/eckpunkte-final-en-data.pdf

Fehérvári István (2001): *A földrajzi tér, különösen az időjárás és a terep hatása a szárazföldi csapatok harcára.* PhD thesis. Budapest: Zrínyi Miklós Nemzetvédelmi Egyetem. Online: http://ludovika.lnkiy.in/Fehervari_2001

Femia, Francesco – Werrell, Caitlin (2012): U.S. Secretary of Defense Leon Panetta on Climate Change and National Security. *The Center for Climate and Security,* 05 March 2012. Online: https://climateandsecurity.org/2012/03/u-s-secretary-of-defense-leon-panetta-on-climate-change-and-national-security

Firigato, Joao Otavio Nascimento (2020): Water Level Monitoring of Grand Ethiopian Renaissance Dam using SAR. *Medium,* 23 July 2020. Online: https://joaootavionf007.medium.com/water-level-monitoring-of-grand-ethiopian-renaissance-dam-using-sar-data-aa5ecf7ce31

Foley, Catherine (2012): *Military Basing and Climate Change.* Online: http://www.americansecurityproject.org/wp-content/uploads/2012/11/Military-Basing-and-Climate-Change.pdf

Forzieria, Giovanni – Bianchi, Alessandra – Batista e Silva, Filipe – Marin Herrera, Mario A. – Leblois, Antoine – Lavalle, Carlo – Aerts, Jeroen C.J.H. – Feyen, Luc (2018): Escalating Impacts of Climate Extremes on Critical Infrastructures in Europe. *Global Environmental Change,* 48, 97–107. Online: https://doi.org/10.1016/j.gloenvcha.2017.11.007

Földi László (2013): A klímaváltozás jelentette kihívások az ABV védelemben. *Hadtudomány,* 23(eSpec), 101–116. Online: http://www.mhtt.eu/hadtudomany/2013/eghajlatvaltozas.pdf

French, Adam – Mechler, Reinhard – Arestegui, Miguel – MacClune, Karen – Cisneros, Abel (2020): Root Causes of Recurrent Catastrophe: The Political Ecology of El Niño-related Disasters in Peru. *International Journal of Disaster Risk Reduction,* 47. Online: https://doi.org/10.1016/j.ijdrr.2020.101539

Fülöp Sándor (2020): Miért (nem) lesz háború a víz miatt? Konfliktusok lehetséges kezelése egy vízhiányos világban. *Másfélfok,* 28 December 2020. Online: https://masfelfok.hu/2020/12/28/miert-nem-lesz-haboru-a-viz-miatt-konfliktusok-lehetseges-kezelese-egy-vizhianyos-vilagban

Gilbert, Scott (2004): Environmental Warfare and US Foreign Policy: The Ultimate Weapon of Mass Destruction. *Global Research,* January 2004. Online: http://www.globalresearch.ca/articles/GIL401A.html

Gleick, Peter (2020): *Opinion – Water Scarcity Will Increase Risk of Conflict, Says New National Intelligence Report.* Online: www.circleofblue.org/2020/world/opinion-water-scarcity-will-increase-risk-of-conflict-says-new-national-intelligence-report

Global Britain in a Competitive Age. The Integrated Review of Security, Defence, Development and Foreign Policy (2021). Presented to Parliament by the Prime Minister by Command of Her Majesty, 17 March 2021.

Global Times (2020): The Chinese Military's New Cold-Weather Quilts Effective at Minus 40 °C. *Global Times,* 19 October 2020. Online: https://www.globaltimes.cn/content/1203873.shtml

GlobalPost (2012): The Reality of Climate Change Can No Longer be Ignored. *The World,* 10 November 2012. Online: https://www.pri.org/stories/2012-11-10/reality-climate-change-can-no-longer-be-ignored

Goble, Paul (2020): Critical Water Shortage in Crimea May Prompt New Russian Move Against Ukraine. *Euromaiden Press,* 24 May 2020.

Goodman, Sherri – Sullivan, Gordon (2019): Climate Change Threatens the Backbone of America's Global Power. *The Hill,* 22 September 2019. Online: https://thehill.com/opinion/energy-environment/462044-climate-change-threatens-the-backbone-of-americas-global-power

Gross, Judah Ari (2020): Fighter Jets Damaged in Weekend Flooding; Repairs to Cost Tens of Millions. *The Times of Israel,* 12 January 2020. Online: www.timesofisrael.com/fighter-jets-damaged-in-weekend-flooding-repairs-to-cost-millions

Halász Marianna (2014): *„Az éghajlatváltozás, a szélsőséges időjárás, különböző hőmérsékletek hatása a honvédségnél rendszeresített ruházatra" című katonai ruházati mérések és a szubjektív felmérések elemzése, értékelése, javaslatok a ruházati termékek módosítására*. Research paper, manuscript.

Halmai Katalin (2021): Bemutatkozott a NATO-ban az új amerikai külügyminiszter. *Népszava,* 23 March 2021. Online: https://nepszava.hu/3114065_bemutatkozott-a-nato-ban-az-uj-amerikai-kulugyminiszter

Hankó Márta – Földi László (2008): "Divatos" gondolatok a klímaváltozásról. *Hadmérnök,* 3(1), 20–26. Online: http://hadmernok.hu/archivum/2008/1/2008_1_hanko.pdf

Hoffman, Max – Grigera, Ana I. (2013): Climate Change, Migration and Conflict in the Amazon and Andes. *CAP* [The Center of American Progress], 26 February 2013. Online: www.americanprogress.org/issues/security/report/2013/02/26/54570/climate-change-migration-and-conflict-in-the-amazon-and-the-andes

Hofmann, Charles-Antoine – Hudson, Laura (2009): Military Responses to Natural Disasters: Last Resort or Inevitable Trend? *Humanitarian Exchange,* 44, 29–31. Online: https://odihpn.org/magazine/military-responses-to-natural-disasters-last-resort-or-inevitable-trend

Honvédelem.hu (2016): Megújul a Honvédelmi Katasztrófavédelmi Rendszer eszközparkja. *Honvedelem.hu,* 28 September 2016. Online: https://honvedelem.hu/cikk/59555_megujul_a_honvedelmi_katasztrofavedelmi_rendszer_eszkozparkja

Honvédelem.hu (2017): Energetikai fejlesztések az MH Egészségügyi Központ épületeiben. *Honvedelem.hu,* 31 January 2017. Online: https://honvedelem.hu/hirek/hazai-hirek/energetikai-fejlesztesek-az-mh-egeszsegugyi-kozpont-epuleteiben.html

Honvédelem.hu (2022): Újabb épületenergetikai fejlesztés valósult meg. *Honvedelem.hu,* 08 August 2022. Online: https://honvedelem.hu/hirek/ujabb-epuletenergetikai-fejlesztes-valosult-meg.html

Hsiang, Solomon M. – Meng, Kyle C. – Cane, Mark A. (2011): Civil Conflicts are Associated with the Global Climate. *Nature,* 476(7361), 438–441. Online: https://doi.org/10.1038/nature10311

Hullám István (2013): Műveleti területek szélsőséges klimatikus tényezőinek hatása a katona pszichikai-mentális teljesítményére. *Hadtudomány,* 23(eSpec), 83–100. Online: http://www.mhtt.eu/hadtudomany/2013/eghajlatvaltozas.pdf

IMCCS (2020): *The World Climate and Security Report 2020.* Expert Group of the International Military Council on Climate and Security, February 2020. Online: https://climateandsecurity.org/worldclimatesecurityreport2020/

IMCCS (2021): *The World Climate and Security Report (WCSR) 2021.* Expert Group of the International Military Council on Climate and Security, June 2021. Online: https://imccs.org/wp-content/uploads/2021/06/World-Climate-and-Security-Report-2021.pdf

Indian Army [s. a.]: *Disaster Relief.* Online: https://indianarmy.nic.in/Site/FormTemplete/frmTempSimple.aspx?MnId=9THKUgbL18Gmzc1zsMSi2g==&ParentID=OpIyinJKEbbf4xNPsavQyw

InfoRádió (2020): A kártevők is a klímaváltozás miatt árasztanak el minket. *Infostart,* 22 November 2020. Online: https://infostart.hu/belfold/2020/11/22/a-kartevok-is-a-klimavaltozas-miatt-arasztanak-el-minket

International Organization for Migration (2010): *World Migration Report 2010: The Future of Migration – Building Capacities for Change.* Online: https://documentation.lastradainternational.org/lsidocs/2572-wmr_2010_english.pdf

IPCC (2021): *AR6 Climate Change 2021: The Physical Science Basis.* Online: https://www.ipcc.ch/report/ar6/wg1/#FullReport

Kákai László – Kacziba Péter – Glied Viktor – Vörös Zoltán (2019): 21. századi vízdiplomácia – A Mekong folyó esete. *Nemzet és Biztonság,* 12(3), 104–124. Online: https://doi.org/10.32576/nb.2019.3.9

Kim, Felix (2021): Japan's Defense Forces Master Disaster Relief Skills with Heavy Workload. *Indo-Pacific Defence Forum,* 29 August 2021. Online: https://ipdefenseforum.com/2021/08/japans-defense-forces-master-disaster-relief-skills-with-heavy-workload

Kiss Csaba (2021): Elképesztő jelentéssel állt elő az amerikai titkosszolgálat: Mad Max-szerű világban fogunk élni, ha így folytatjuk. *Portfolio,* 26 October 2021. Online: https://www.portfolio.hu/global/20211026/elkepeszto-jelentessel-allt-elo-az-amerikai-titkosszolgalat-mad-max-szeru-vilagban-fogunk-elni-ha-igy-folytatjuk-507054

Klare, Michael (2020): A Military Perspective on Climate Change could Bridge the Gap between Believers and Doubters. *The Conversation,* 18 February 2020. Online: https://theconversation.com/a-military-perspective-on-climate-change-could-bridge-the-gap-between-believers-and-doubters-128609

Klímablog (2015): Bűnözők húznak hasznot a vízhiányból. *Piac és Profit,* 08 March 2015. Online: https://piacesprofit.hu/klimablog/bunozok-huznak-hasznot-a-vizhianybol/2

Kohut László – Koller József – Lévay Gábor – Padányi József (2010): *Az éghajlatváltozás hatása és a katonai erő.* Budapest: Stratégiai és Védelmi Kutatóintézet.

Komócsin Sándor – Barabás Júlia (2020): Szeptemberben háború törhet ki Európában [War Could Break Out in Europe in September]. *Napi.hu,* 02 August 2020. Online: https://www.napi.hu/nemzetkozi-gazdasag/szeptemberben-haboru-torhet-ki-europaban.710867.html

Koren, Haim – Behar, Gideon (2020): Security in the Shadow of Climate Change in the Sahel. *Moshe Dayan Center,* 29 August 2020. Online: https://dayan.org/content/security-shadow-climate-change-sahel

Kovács, Ferenc (2013): The Green Barracks Program. *Hadtudomány,* 23(eSpec), 67–82. Online: http://www.mhtt.eu/hadtudomany/2013/eghajlatvaltozas.pdf

Kozics Júlia (2022): Négy napig oltották a tüzet Szlovéniában a magyar katonák [Hungarian Soldiers Have Fought the Fire in Slovenia for Four Days]. *Index.hu,* 25 July 2022. Online: https://index.hu/kulfold/2022/07/25/szlovenia-erdotuz-hohullam-magyar-honved-seg-tuzoltas

Le Blanc, Steven – Register, Katherine E. (2004): *Constant Battles. Why We Fight.* New York: St. Martin's. Online: https://archive.org/details/constantbattleswoolebl

Lewis, Jangira (2021): US Military Pollution: The World's Biggest Climate Change Enabler. *Earth.org,* 12 November 2021. Online: https://earth.org/us-military-pollution

Lomborg, Bjørn (2011): Food Security: The Seed of Solution is Already Here. *NATO Review,* 18 February 2011. Online: https://www.nato.int/docu/review/articles/2011/02/18/food-security-the-seed-of-solution-is-already-here/index.html

Lukashova, Sonya [Лукашова, Соня] – Reshchuk, Katerina [Рещук, Катерина] (2020): Що відбувається з окупованим Кримом без дніпровської води. 13 фактів. *Українська правда,* 19 February 2020. Online: https://www.pravda.com.ua/articles/2020/02/19/7240920/

Mach, Katharine J. – Kraan, Caroline M. – Adger, W. Neil – Buhaug, Halvard – Burke, Marshall – Fearon, James D. – Field, Christopher B. – Hendrix, Cullen S. – Maystadt, Jean-Francois – O'Loughlin, John – Roessler, Philip – Scheffran, Jürgen – Schultz, Kenneth A. – Uexkull, Nina von (2019): Climate as a Risk Factor for Armed Conflict. *Nature,* 571(7764), 193–197. Online: https://doi.org/10.1038/s41586-019-1300-6

Magyar Zoltán – Révai Tamás – Lenkovics László – Budulski László (2014): *Az éghajlatváltozás, a szélsőséges időjárás, különböző hőmérsékletek hatása a honvédségnél rendszeresített ruházatra.* Research paper, manuscript.

Malewar, Amit (2020): Emerge Shows its Hybrid-Electric STOUT Military Aircraft. *Inceptive Mind,* 17 November 2020. Online: www.inceptivemind.com/emerge-shows-hybrid-electric-stout-military-aircraft/16213

Manning, Jeane – Begich, Nick (1997): *Angels Don't Play this HAARP: Advances in Tesla Technology.* Eagle River, AK: Earthpulse Press.

March, Raquel (2017): McKinley Climatic Laboratory. *Eglin Air Force Base,* 24 January 2017. Online: www.eglin.af.mil/News/Article-Display/Article/1086166/mckinley-climatic-laboratory

Maxwell, Mary Jane (2018): Iran Arrests Scientists Trying to Solve Water Crisis. *Share America,* 03 August 2018. Online: https://share.america.gov/iran-arrests-scientists-trying-to-solve-water-crisis

McSheffrey, Elizabeth – McArthur, Aaron (2021): As More Military Troops Head to B.C., Experts Call for Civilian Disaster Response Solution. *Global News,* 17 November 2021. Online: https://globalnews.ca/news/8381464/experts-civilian-disaster-response-bc

Mehta, Aaron (2021): Climate Change is Now a National Security Priority for the Pentagon. *Defense News,* 27 January 2021. Online: www.defensenews.com/pentagon/2021/01/27/climate-change-is-now-a-national-security-priority-for-the-pentagon

Miller, Klaude A. – Draker, David L. (2006): Combat Support Brigade. *Engineer,* January–March 2006.

Ministry of Defence (2012): *Hungary's National Military Strategy.* Online: https://www.files.ethz.ch/isn/167317/Hungary%202012%20national_military_strategy.pdf

Ministry of Defence (2014): *Strategic Trends Programme. Global Strategic Trends – Out to 2040.* Online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/654717/GST4_v9_Feb10_archived.pdf

Ministry of Defence (2021): Preparing for Missions in the Caribbean. *Medium,* 24 June 2021. Online: https://medium.com/voices-of-the-armed-forces/preparing-for-missions-in-the-caribbean-a39c606be094

Ministry of Foreign Affairs of Hungary (2012): *Hungary's National Security Strategy 2012.* Online: https://eda.europa.eu/docs/default-source/documents/hungary-national-security-strategy-2012.pdf

Molnár Csaba (2009): Esőistent játszani. *Magyar Nemzet,* 07 November 2009. Online: https://magyarnemzet.hu/archivum-magyarnemzet/2009/11/esoistent-jatszani

Molnár Szabina (2021): Kínára, a klímaváltozásra és a koronavírusra fókuszál az amerikai külpolitika. *Index,* 04 March 2021. Online: https://index.hu/kulfold/2021/03/04/washington-peking-anthony-blinken-egyesult-allamok-diplomcia

MTI (2014): Ukrajna elzárta a Krím félsziget vízcsapját. *HVG,* 26 April 2014. Online: http://hvg.hu/vilag/20140426_Ukrajna_elzarta_a_Krim_felszigetet_vizcsa

MTI (2015): A klímaváltozás is okolható a szíriai polgárháborúért. *Origo,* 06 March 2015. Online: http://www.origo.hu/kornyezet/20150306-a-klimavaltozas-is-okolhato-a-sziriai-polgarhaboruert.html

MTI (2018): Hatmillió ember éhezik a Szahel-övezetben. *Orientalista.hu,* 14 June 2018. Online: https://orientalista.hu/blog-post/hatmillio-ember-ehezik-a-szahel-ovezetben

MTI (2020): Éghajlatváltozás: nemzetközi összefogást sürget Biden. *Világgazdaság,* 20 December 2020. Online: https://www.vg.hu/kozelet/kornyezetvedelem/eghajlatvaltozas-nemzetkozi-osszefogast-surget-biden-3440764

MTI (2021a): Egyre jobban érzik a németek a klímaváltozást és drámai jóslatot mondott az időjárási szolgálat elnöke. *Portfolio,* 09 March 2021. Online: https://www.portfolio.hu/gazdasag/20210309/egyre-jobban-erzik-a-nemetek-a-klimavaltozast-es-dramai-joslatot-mondott-az-idojarasi-szolgalat-elnoke-473366

MTI (2021b): A NATO főtitkára megnevezte a legnagyobb biztonsági fenyegetéseket. *Portfolio,* 16 March 2021. Online: https://www.portfolio.hu/global/20210316/a-nato-fotitkara-megnevezte-a-legnagyobb-biztonsagi-fenyegeteseket-474386

Myers, Meghann (2020): DoD Spends Millions on Protecting Bases from Climate Change but Fails to Track Program Impact, Report Says. *Military Times,* 22 December 2020.

Nagashima, Jun (2021): Climate Change as an Operational Domain: Sustainable Military Review Will Begin after UN IPCC Report. *SPF* [The Sasakawa Peace Foundation], 31 August 2021. Online: https://www.spf.org/iina/en/articles/nagashima_08.html

National Defence (2017): *Strong Secure Engaged. Canada's Defence Policy*. Online: http://dgpaapp.forces.gc.ca/en/canada-defence-policy/docs/canada-defence-policy-report.pdf

National Intelligence Council (2021): *Climate Change and International Responses Increasing Challenges to US National Security Through 2040. NIC-NIE-2021-10030-A*. Online: https://www.dni.gov/files/ODNI/documents/assessments/NIE_Climate_Change_and_National_Security.pdf

NATO (2020): NATO 2030: United for a New Era. Analysis and Recommendations of the Reflection Group Appointed by the NATO Secretary General. Online: www.nato.int/nato_static_fl2014/assets/pdf/2020/12/pdf/201201-Reflection-Group-Final-Report-Uni.pdf

NATO (2021): Brussels Summit Communiqué. Issued by the Heads of State and Government Participating in the Meeting of the North Atlantic Council in Brussels 14 June 2021. Online: https://www.nato.int/cps/en/natohq/news_185000.htm

NATO (2022): *Madrid Summit Declaration.* Issued by NATO Heads of State and Government participating in the meeting of the North Atlantic Council in Madrid, 29 June 2022. Online: https://www.nato.int/cps/en/natohq/official_texts_196951.htm?selectedLocale=en

Németh Márton Sándor (2021): A klímacsúcs értékelése: egy lépés a jó irányba. *Index,* 17 November 2021. Online: https://index.hu/belfold/2021/11/17/meg-nem-vagyunk-ott-ahol-kellene-de-legalabb-sikerult-megtenni-par-lepest

Népszava (2014): Putyin a sarkvidéken erősít. *Népszava,* 23 April 2014. Online: https://nepszava.hu/1018121_putyin-a-sarkvideken-erosit

Népszava (2015): Vízzel támad az Iszlám Állam. *Népszava,* 07 June 2015. Online: https://nepszava.hu/1059272_vizzel-tamad-az-iszlam-allam

Norris, Guy (2016): Up Close: Lockheed Martin's LMH-1 Hybrid Airship. *Aviation Week,* 30 March 2016. Online: https://aviationweek.com/aerospace/close-lockheed-martins-lmh-1-hybrid-airship

Nyitrai Mihály (2018): NATO Smart Energia. *Hadmérnök,* 13(1), 104–117. Online: http://hadmernok.hu/181_08_nyitrai.pdf

Office of the Assistant Secretary of Defense (Energy, Installations & Environment) Environment, Safety & Occupational Health Directorate (2014): *Department of Defense.*

Office of the Under Secretary of Defense for Acquisition and Sustainment (2019): *Report on Effects of a Changing Climate to the Department of Defense.* Online: https://climateandsecurity.files.wordpress.com/2019/01/sec_335_ndaa-report_effects_of_a_changing_climate_to_dod.pdf

Origo (2021): Vízhiány vezethet súlyos problémákhoz Iránban. *Origo,* 11 June 2021. Online: https://www.origo.hu/gazdasag/20210528-iran-vizhiany-gazdasag-klimavalsag.html

Padányi József (2010): Az éghajlatváltozás hatása és a katonai erő. In Padányi József – Kohut László – Koller József – Lévay Gábor: *Az éghajlatváltozás hatása a biztonságra és a katonai erő alkalmazására.* Budapest: Stratégiai és Védelmi Kutatóintézet, 32–46.

Padányi József (2012): Az éghajlatváltozás és a katonai erő viszonyrendszere a nemzetközi kutatások tükrében. *Repüléstudományi Közlemények,* 24(2), 111–118. Online: http://hdl.handle.net/20.500.12944/100342

Padányi József (2015): Vízkonfliktusok. *Hadtudomány,* 25(eIssue), 272–284. Online: https://www.mhtt.eu/hadtudomany/2015/2015_elektronikus/23_PADANYI_JOZSEF.pdf

Padányi József (2021): Az éghajlatváltozás hatásai, mint a katonai erő előtt álló biztonsági kihívások. *Hadtudomány,* 31(1), 31–45. Online: https://doi.org/10.17047/HADTUD.2021.31.1.31

Palkó István (2014): Krími válság – Ukrajna adu ásza: az édesvíz. *Kárpátalja,* 20 March 2014. Online: http://www.karpataljalap.net/?q=2014/03/20/krimi-valsag-ukrajna-adu-asza-az-edesviz

Péliné Németh Csilla (2021): Extrém szélsebességű viharokat hoz a klímaváltozás Magyarországon. *Másfélfok,* 07 May 2021. Online: https://masfelfok.hu/2021/05/07/extrem-szelsebessegu-viharokat-hoz-a-klimavaltozas-magyarorszagon

Pontin, Mark Williams (2008): Weather Engineering in China. How the Chinese Plan to Modify the Weather in Beijing during the Olympics, Using Supercomputers and Artillery. *MIT Technology Review,* 25 March 2008. Online: www.technologyreview.com/2008/03/25/270084/weather-engineering-in-china

PRC Information Office of the State Council (2013): *The Diversified Employment of China's Armed Forces.* Online: http://www.andrewerickson.com/wp-content/uploads/2019/07/China-Defense-White-Paper_2013_English-Chinese_Annotated.pdf

Press, Anthony – Bergin, Anthony – Garnsey, Eliza (2013): *Special Report Issue 49 – Heavy Weather: Climate and the Australian Defence Force.* Canberra: Australian Strategic Policy Institute. Online: https://www.aspi.org.au/publications/special-report-issue-49-heavy-weather-climate-and-the-australian-defence-force/SR49_heavy_weather.pdf

Qubit (2019): Egymilliárd ember kelhet útra 2050-ig a klímaváltozás miatt, de fogalmunk sincs, mi legyen velük. *Qubit,* 24 September 2019. Online: https://qubit.hu/2019/09/24/egymilliard-ember-kelhet-utra-2050-ig-a-klimavaltozas-miatt-de-fogalmunk-sincs-mi-legyen-veluk

Rácz Réka Magdolna (2008): Az Egyesült Királyság Éghajlatváltozási Programjáról. *Hadtudományi Szemle,* 1(1), 75–84. Online: http://www.epa.hu/02400/02463/00001/pdf/EPA02463_hadtudomanyi_szemle_2008_1_075-084.pdf

Reis, Flávio Américo dos (2018): Military Logistics in Natural Disasters: The Use of the NATO Response Force in Assistance to the Pakistan Earthquake Relief Efforts. *Contexto Internacional,* 40(1), 73–96. Online: https://doi.org/10.1590/S0102-8529.2017400100004

Reliefweb (2021a): Quarterly Mixed Migration Update East Africa & Yemen, Quarter 2. *ReliefWeb,* 22 July 2021. Online: https://reliefweb.int/report/world/quarterly-mixed-migration-update-east-africa-yemen-quarter-2-2021

Reliefweb (2021b): Turnover Ceremony of Humanitarian Assistance and Disaster Relief (HA/DR) Equipment to the Department of National Defense (DND). *ReliefWeb,* 07 October 2021. Online: https://reliefweb.int/report/philippines/turnover-ceremony-humanitarian-assistance-and-disaster-relief-hadr-equipment

Reuters (2021): NATO Leaders to Discuss Russian Disinformation, China – Merkel. *Reuters,* 14 June 2021. Online: https://reut.rs/3nLCZSB

Richardson, Annie (2021): Exercise Planning for Disaster Relief. *Defence News,* 29 November 2021. Online: https://news.defence.gov.au/capability/exercise-planning-disaster-relief

RNZ (2021): PNG Seeks Climate Collaboration from Industrialised Nations. *Radio New Zealand,* 22 September 2021. Online: https://www.rnz.co.nz/international/pacific-news/452053/png-seeks-climate-collaboration-from-industrialised-nations

Rónay Tamás (2014): Harc a vízért a Közel-Keleten és Ázsiában. *Népszava,* 18 August 2014. Online: https://nepszava.hu/1030578_harc-a-vizert-a-kozel-keleten-es-azsiaban

Ros, Miquel (2021): The "Caspian Sea Monster" Rises from the Grave. *CNN,* 30 December 2021. Online: https://cnn.it/3yGoUcG

RT (2015): Russian Military Begin Extensive Water Pipeline Project in Crimea. *RT.com,* 04 April 2015. Online: http://rt.com/news/246725-crimea-water-pipeline-project

S. M. (2003): A geo-hadviseléstől bolondul meg az időjárás? *Transindex,* 29 August 2003. Online: https://eletmod.transindex.ro/?cikk=1798

Sands, Christopher (2021): Canada–US Law Institute Conference on Climate Change and the Arctic. *LinkedIn,* 18 April 2021. Online: https://www.linkedin.com/pulse/canada-us-law-institute-conference-climate-change-arctic-sands

Schwartz, Peter – Randall, Doug (2003): *An Abrupt Climate Change Scenario and Its Implications for United States National Security*. Online: https://www.iatp.org/sites/default/files/An_Abrupt_Climate_Change_Scenario_and_Its_Impl.pdf

Scuticchio, Pablo (2015): Growing Role of Armed Forces in Disaster Relief a Dangerous Trend for Latin America. *New Security Beat,* 22 October 2015. Online: www.newsecuritybeat.org/2015/10/growing-role-armed-forces-disaster-relief-dangerous-trend-latin-america

Shadwick, Martin (2018): The Canadian Armed Forces and Humanitarian Assistance and Disaster Relief (HADR). *Canadian Military Journal,* 18(4), 76–83. Online: http://www.journal.forces.gc.ca/vol18/no4/PDF/CMJ184Ep76.pdf

Shukman, David (2021): Climate Change: Sir David Attenborough in "Act Now" Warning. *BBC News,* 26 October 2021. Online: https://bbc.in/3NLJi38

Siklós András (2021): Vízválság fenyeget: Ukrajna továbbra sem ad ivóvizet a Krímben élőknek. *Index,* 27 May 2021. Online: https://index.hu/kulfold/2021/05/27/ukrajna-krim-felsziget-oroszorszag-vizhiany-szankciok/?token=f64fc729ffd5cd9b9ce05f3b91be1f7d

Southerland, Matthew (2019): *The Chinese Military's Role in Overseas Humanitarian Assistance and Disaster Relief: Contributions and Concerns.* U.S.–China Economic and Security Review Commission, 11 July 2019. Online: http://ludovika.lnkiy.in/Southerland_2019

Staalesen, Atle (2020): Putin Takes a Look at New Aircraft Carrier. *The Barents Observer,* 10 January 2020. Online: https://thebarentsobserver.com/en/security/2020/01/putin-takes-look-new-aircraft-carrier

Stanley, Bruce (2021): US Military Destabilised by Climate Change in the Middle East. *OrientXXI,* 28 June 2021. Online: https://orientxxi.info/magazine/us-military-destabilised-by-climate-change-in-the-middle-east,4885

Steffen, Will – Hughes, Lesley (2013): *The Critical Decade Report 2013. Climate Change Science, Risks and Responses. Canberra:* Climate Commission Commonwealth of Australia. Online: https://www.climatecouncil.org.au/uploads/b7e53b20a7d6573e-1ab269d36bb9b07c.pdf

Stier Gábor (2020): Az Arktiszon át vezet a XXI. század új Szuezi-csatornája. *Magyar Hang,* 18 October 2020. Online: https://hang.hu/kulfold/az-arktiszon-at-vezet-a-xxi-szazad-uj-szuezi-csatornaja-111618

Stoltenberg, Jens (2021): *Food for Thought Paper: NATO 2030 – A Transatlantic Agenda for the Future.* Online: https://open.overheid.nl/documenten/ronl-21eed80f-0a1f-4ebe-b091-9bf8bf7bde42/pdf

Surkes, Sue (2021): Is Israel Burying its Head in Sand as Climate Change Makes Mideast a Hot Mess? *The Times of Israel,* 11 March 2021. Online: www.timesofisrael.com/is-israel-burying-its-head-in-sand-as-climate-change-makes-mideast-a-hot-mess

Sybert, Sarah (2020): Army Futures Command to Develop Electric Powered Vehicles; LTG Eric Wesley Quoted. *ExecutiveGov,* 21 September 2020. Online: www.executivegov.com/2020/09/army-futures-command-to-develop-electric-powered-vehicles-ltg-eric-wesley-quoted

Szabó József (2014): Kairói vízparancsolat: ne lopj! *Magyar Szó online,* 20 April 2014. Online: https://www.magyarszo.rs/hu/2314/kulfold_nagyvilag/110506/Kair%C3%B3i-v%C3%ADzparancsolat-Ne-lopj!.htm

Szabó Péter (2022): Harmadával csökkent a fagyos napok száma az elmúlt 120 évben Magyarországon a klímaváltozás miatt. *Másfélfok,* 07 January 2022. Online: https://masfelfok.hu/2022/01/07/harmadaval-csokkent-a-fagyos-napok-szama-az-elmult-120-evben-magyarorszagon-a-klimavaltozas-miatt

Székely Ferenc (2021): Biden már az új világrendre akarja szabni az amerikai haderőt. *Euronews,* 21 June 2021. Online: https://hu.euronews.com/2021/03/17/biden-mar-az-uj-vilagrendre-akarja-szabni-az-amerikai-haderot

Szobonya Nikoletta (2020): Működésben az Országos Jégkármérséklő Rendszer. *Greendex,* 20 October 2020. Online: https://greendex.hu/mukodesben-az-orszagos-jegkarmerseklo-rendszer

Szűcs László (2014): Amikor az időjárás alakítja vagy írja át a haditervet. *Honvedelem.hu,* 15 February 2014. Online: https://honvedelem.hu/hatter/multidezo/amikor-az-idojaras-alakitja-vagy-irja-at-a-haditervet.html

Tan, Michelle (2015): Interview: US Army Secretary John McHugh. *Defense News,* 21 October 2015. Online: www.defensenews.com/interviews/2015/10/21/interview-us-army-secretary-john-mchugh

Taub, Benjamin (2021): Madagascar is Experiencing The World's First Famine Caused Entirely by Climate Change. *IFLScience,* 25 August 2021. Online: www.iflscience.com/environment/madagascar-experiencing-worlds-first-famine-caused-entirely-climate-change

Tiezzi, Shannon (2014): The Softer Side of China's Military. *The Diplomat,* 18 August 2014. Online: https://thediplomat.com/2014/08/the-softer-side-of-chinas-military

Tokovicz József – Kádár Pál – Süle Attila – Borsos József – Juhász László – Petneházi Ferenc – Molnár László (2012): *A Magyar Honvédség képességei és a katasztrófaelhárítás kihívásai 2000–2011.* Budapest: HM Zrínyi Média.

Trakimavičius, Lukas (2021): Why Europe's Militaries Should Worry about Climate Change? *Euractiv,* 17 August 2021. Online: www.euractiv.com/section/defence-and-security/opinion/why-europes-militaries-should-worry-about-climate-change

Tranquillius (2015): Végül kiszárad a Csád-tó is? *Pangea,* 04 January 2015. Online: https://pangea.blog.hu/2015/01/04/vegul_kiszarad_a_csad_to_is

UK Ministry of Defence (2021): *Climate Change and Sustainability Strategic Approach.* Online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/973707/20210326_Climate_Change_Sust_Strategy_v1.pdf

UNESCO (2015): *The United Nations World Water Development Report 2015: Water for a Sustainable World.* Online: https://bit.ly/3P66ZnU

UNICEF (2021): *Sahel Crisis: 29 Million Sahelians Need Humanitarian Assistance and Protection.* Online: https://www.unicef.org/wca/press-releases/sahel-crisis-29-million-sahelians-need-humanitarian-assistance-and-protection

University of Alaska (2023): The High-frequency Active Auroral Research Program. Online: http://www.haarp.alaska.edu

US Army War College (2019): *Implications of Climate Change for the U.S. Army.* Online: https://climateandsecurity.files.wordpress.com/2019/07/implications-of-climate-change-for-us-army_army-war-college_2019.pdf

US Department of Defense (2010): *Quadrennial Defense Review Report.* Online: http://www.livreblancdefenseetsecurite.gouv.fr/pdf/2010_02-us-qdr.pdf

US Department of Defense (2011): *Energy for the Warfighter: Operational Energy Strategy.* Online: https://breakingenergy.com/documents/energy-for-the-warfighter-the-militarys-operational-energy-str/

US Department of Defense (2014): *2014 Climate Change Adaptation Roadmap.* Online: https://www.acq.osd.mil/eie/downloads/CCARprint_wForward_e.pdf

US Office of the Director of National Intelligence (2012): *Global Water Security. Intelligence Community Assessment. ICA 2012-08*. Online: https://www.dni.gov/files/documents/Special%20Report_ICA%20Global%20Water%20Security.pdf

Végvári Zsolt (2021): A hidrogén lehetséges honvédelmi (katonai) alkalmazása. *Haditechnika,* 55(1), 20–25. Online: https://doi.org/10.23713/HT.55.1.04

Végvári Zsolt – Király László (2017): Energiahatékonyság a Magyar Honvédség béke időszaki működésében. *Hadtudomány,* 27(3–4), 54–73.

Vidal, John (2014): Water Supply Key to Outcome of Conflicts in Iraq and Syria, Experts Warn. *The Guardian*, 02 July 2014. Online: http://www.theguardian.com/environment/2014/jul/02/water-key-conflict-iraq-syria-isis

Világ Figyelő [s. a.]: *Kína saját HAARP időjárás befolyásoló rendszert üzemeltet: ott csinálnak esőt, ahol csak akarnak.* Online: https://vilagfigyelo.com/kina-sajat-haarp-idojaras-befolyasolo-rendszert-uzemeltet-ott-csinalnak-esot-ahol-csak-akarnak/#docst

VOMIT (2001): Védőpajzs rádióhullámokból? [A Shield Made of Radio Waves?] *Index,* 31 May 2001. Online: http://index.hu/tudomany/haarp/

Vynogradova, Polina (2020): The Water Crisis in Crimea. *Geopolitical Monitor,* 24 April 2020. Online: www.geopoliticalmonitor.com/backgrounder-the-water-crisis-in-crimea

Waldman, Scott (2018): Key Missile Defense Installation Will Be Uninhabitable in Less Than 20 Years. *Scientific American,* 01 March 2018. Online: www.scientificamerican.com/article/key-missile-defense-installation-will-be-uninhabitable-in-less-than-20-years

Wallace, Joe (2021): Natural Disasters at Military Bases. *Veteran.com,* 20 March 2021. Online: https://veteran.com/natural-disasters-bases

Wehrmann, Benjamin (2020): German Military Needs to Adapt to Momentous Climate Change Challenges – Defence Minister. *Clean Energy Wire,* 06 October 2020. Online: https://www.cleanenergywire.org/news/german-military-needs-adapt-momentous-climate-change-challenges-defence-minister

Werrell, Caitlin – Femia, Francesco (2016): Secretary Gates: National Security Implications of Climate Change "Very Real". *The Center for Climate and Security,* 19 May 2016. Online: https://climateandsecurity.org/2016/05/secretary-gates-national-security-implications-of-climate-change-very-real

Werz, Michael – Conley, Laura (2012): Climate Change, Migration and Conflict in Northwest Africa. *CAP* [Center of American Progress], 18 April 2012. Online: www.americanprogress.org/issues/security/report/2012/04/18/11439/climate-change-migration-and-conflict-in-northwest-africa

Werz, Michael – Hoffman, Max (2013): Climate Change, Migration, and Conflict 33. In Werrell, Caitlin E. – Femia, Francesco (eds.): *The Arab Spring and Climate Change.* Online: https://climateandsecurity.org/wp-content/uploads/2018/07/the-arab-spring-and-climate-change_2013_02.pdf

Wettengel, Julian (2019): "Climate Action Is Our New Foreign Policy Imperative" – German Foreign Minister. *Clean Energy Wire,* 04 June 2019. Online: https://www.cleanenergywire.org/news/climate-action-our-new-foreign-policy-imperative-german-foreign-minister

Wikipedia (2023a): *Felkelés Dzsammu és Kasmír államban*. Online: https://w.wiki/5QG9
Wikipedia (2023b): *North Crimean Canal*. Online: https://w.wiki/5QHG
Woodall, Bernie (2008): Military Wants to Lead U.S. into the Green. *Reuters,* 08 August 2008. Online: https://reut.rs/3P9TvYB
World Meteorological Organization (2021): *WMO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970–2019).* Online: https://public.wmo.int/en/media/news/atlas-of-mortality-and-economic-losses-from-weather-climate-and-water-extremes-1970-2019
Xinhua (2021): Xi Focus: Building a Peace-loving World-class Military. *China Daily,* 01 August 2021. Online: https://www.chinadaily.com.cn/a/202108/01/WS6106ad3fa310efa1bd665ce5_1.html
Zabarenko, Deborah (2008): US Army Works to Cut Its Carbon "Bootprint". *Reuters,* 27 July 2008. Online: https://reut.rs/3RbpJEw

Annex I

The main strategic level positions on climate change impacts, in chronological order:

1. 2003: *An Abrupt Climate Change Scenario and Its Implications for United States National Security,* the first Pentagon-commissioned document to outline future scenarios of the consequences of climate change and its implications for national security. The document provides a kind of benchmark for future strategies. Online: https://www.iatp.org/documents/abrupt-climate-change-scenario-and-its-implications-united-states-national-security
2. 2007: *The Age of Consequences: The Foreign Policy and National Security Implications of Global Climate Change,* a major report by leading military and security strategists and foreign policy experts. The report outlines scenarios of possible impacts associated with global temperature increases of 1.3°C, 2.6°C and 5.6°C. Online: https://csis-website-prod.s3.amazonaws.com/s3fs-public/legacy_files/files/media/csis/pubs/071105_ageofconsequences.pdf
3. 2007: *Military Advisory Board: National Security and Threat of Climate Change. The CNA Cooperation, 2007.* This paper argues that the national security risks posed by climate change should be integrated into national defence and national security strategies. Online: https://www.cna.org/cna_files/pdf/national%20security%20and%20the%20threat%20of%20climate%20change.pdf
4. 2008: *Climate Change and International Security.* The European Union agrees that climate change can exacerbate conflict and instability, thus directly affecting European interests and posing political and security risks. Online: https://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/reports/99387.pdf

5. 2008: *Global Trends 2025: A Transformed World*. The report identifies climate change as the cause of an unstable world. Online: https://www.atlanticcouncil.org/wp-content/uploads/2008/11/Global-Trends-2025.pdf
6. *2014: Global Strategic Trends – Out to 2040.* The analysis examines changes in the security environment to help Department of Defense planners and policymakers. Online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/654717/GST4_v9_Feb10_archived.pdf
7. 2010 and 2014: *Quadrennial Defense Review.* The 2010 report identified "energy security and climate change" as one of the four most important issues requiring immediate action. It argues that climate change is exacerbating instability and conflict, which civilian and military authorities cannot leave unaddressed anywhere in the world. Online: https://csis-website-prod.s3.amazonaws.com/s3fs-public/legacy_files/files/publication/090809_qdrahc_revised.pdf
8. 2012: *Global Water Security.* Intelligence Community Assessment ICA 2012-08, 2 February 2012 The analysis points to the fact that access to water is changing. Water scarcity, intensified by other problems, can lead to a state's security being undermined. Online: https://www.dni.gov/files/documents/Special%20Report_ICA%20Global%20Water%20Security.pdf
9. 2012: *Military Green: Energy and Environment at the EDA, 2012.* The report aims to help Member States' defence planners to reduce emissions from military forces. Online: http://euromil.org/wp-content/uploads/2021/03/13_EDA_military-green-leaflet.pdf
10. 2015: *Water for a Sustainable World. The United Nations World Water Development Report 2015.* This report highlights the links between water and human health, food and energy security, industrial growth, urbanisation and climate change. Online: https://sustainabledevelopment.un.org/content/documents/1711Water%20for%20a%20Sustainable%20World.pdf

11. 2015: *UK National Security Strategy and Strategic Defence and Security Review.* The report identifies climate change as a driver of instability. Online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/478933/52309_Cm_9161_NSS_SD_Review_web_only.pdf
12. 2016: *White Paper on German Security Policy and the Future of the Bundeswehr.* Scarcity of resources and population growth, combined with climate change, destabilise states and exacerbate conflicts, especially in fragile regions. Possible consequences are weak states, violent conflicts and mass migration. Germany therefore calls for climate change to be a permanent agenda item in international organisations and fora such as the UN, the EU and the G7. Online: https://issat.dcaf.ch/download/111704/2027268/2016%20White%20Paper.pdf
13. 2016: *Australian Defence White Paper.* Climate change will be a major challenge for Australia and the surrounding countries. Rising temperatures, rising sea levels, and an increase in the frequency and intensity of extreme weather events are the biggest challenges. All these will contribute to environmental degradation, increasing food shortages and hamper economic development. Online: www.files.ethz.ch/isn/172498/Australia%20defense%20WP_2013_web.pdf
14. 2016: *Climate Change, Impacts and Vulnerability in Europe 2016. An Indicator-based Report.* The report is an indicator-based assessment of climate change and its impacts on ecosystems and society. It also addresses the vulnerability of society to climate change, adaptation policies and the development of the necessary knowledge base. Online: www.eea.europa.eu/publications/climate-change-impacts-and-vulnerability-2016
15. 2017: *The Role of Water Stress in Instability and Conflict.* The report analyses the role of water in conflict situations. It looks at water as a tool of coercion, how water scarcity can strengthen the influence of extremist organisations and how it can threaten even stable governments.

Online: https://www.cna.org/CNA_files/pdf/CRM-2017-U-016532-Final.pdf

16. 2017: *Strong Secure Engaged. Canada's Defence Policy.* The Defence Principles make it clear that the military has a key role to play in preventing disasters and actively contributing to their consequences, both in Canada and abroad. This must receive increasing attention due to the growing number of natural disasters caused by climate change, and the federal government is providing all the resources to do so. Online: http://dgpaapp.forces.gc.ca/en/canada-defence-policy/docs/canada-defence-policy-report.pdf
17. 2018: *New Zealand's Strategic Defence Policy.* Climate change, including more frequent extreme weather events, will increase the need for military force to be involved in prevention and consequence management. Military support for civil emergency management will be complemented by tasks in conservation, environmental protection and biosecurity. Online: https://www.defence.govt.nz/assets/Uploads/8958486b29/Strategic-Defence-Policy-Statement-2018.pdf
18. 2018: *COP24 Special Report. Health & Climate Change.* WHO 2018. The report concludes that the severity of the climate change impact becomes increasingly clear. Climate change is the greatest challenge of the 21st century, threatening all parts of society. Further delay in responding to this challenge will result in increasing risks to human life and health. Online: https://apps.who.int/iris/bitstream/handle/10665/276405/9789241514972-eng.pdf
19. 2018: *Council Conclusions on Climate Diplomacy* (26 February 2018). Online: http://euromil.org/wp-content/uploads/2021/03/18_Council_conclusions_climate_diplomacy.pdf
20. 2019: *Report on Effects of a Changing Climate to the Department of Defense.* The report noted that the effects of climate change are considered a national security issue. 79 military installations were assessed for impacts and their possible consequences, with a particular focus on the occurrence of flooding, drought, desertification, permafrost melt and fire

damage. Online: https://media.defense.gov/2019/Jan/29/2002084200/-1/-1/1/CLIMATE-CHANGE-REPORT-2019.PDF

21. 2019: *Implications of Climate Change for the U.S. Army. United States Army War College.* This analysis sets out in detail the impact of climate change on military force and presents the possible (necessary) responses. Online: https://climateandsecurity.files.wordpress.com/2019/07/implications-of-climate-change-for-us-army_army-war-college_2019.pdf

22. 2019: *Improving the Climate for Peace. Berlin Call for Action. Berlin Climate and Security Conference 2019.* The call is structured around three ideas: a thorough and comprehensive analysis of the risks posed by climate change, laying the foundations for effective intervention; increasing the resources available to the UN in this area; and putting climate change, sustainable development, security and peacebuilding at the heart of all action plans. Online: https://berlin-climate-security-conference.de/sites/berlin-climate-security-conference.de/files/documents/berlin_call_for_action_04_june_2019.pdf

23. 2020: *EU Climate Change and Defence Roadmap.* This document examines the capabilities of EU-led missions in extreme weather conditions. It also makes the case for integrating climate change and environmental considerations into strategic plans in all cases. Online: https://www.google.com/search?q=angol+maygar&oq=angol+maygar&aqs=chrome..69i57j0i10i131i433j0i3i10j0i10i131i433j0i10j0i3i10j0i10i131i433j0i10i433j0i10l2.2708j0j7&sourceid=chrome&ie=UTF-8

24. 2020: Louise van Schaik – Dick Zandee – Tobias von Lossow – Brigitte Dekker – Zola van der Maas – Ahmad Halima: *Ready for Take-off? Military Responses to Climate Change. Clingendael Report.* March 2020 Online: https://www.clingendael.org/sites/default/files/2020-03/Report_Military_Responses_to_Climate_Change_March_2020.pdf

25. 2021: *The World Climate and Security Report (WCSR) 2021.* One of the report's key findings is that increasingly systemic crises, triggered or exacerbated by climate change, are overstretching military forces

in ways that weaken their traditional capabilities. Online: https://imccs.org/wp-content/uploads/2021/06/World-Climate-and-Security-Report-2021.pdf

26. 2021: *UK Ministry of Defence Climate Change and Sustainability Strategic Approach.* The UK defence sector has a key role to play in addressing climate change and security risks. To this end, reducing emissions from the military is a priority for development. Online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/973707/20210326_Climate_Change_Sust_Strategy_v1.pdf
27. 2021: *NATO Climate Change and Security Action Plan.* The document proposes strategies to better assess climate risks and prepare assets and operations for the impacts of climate change, and makes cautious pledges on defence emissions. Online: https://www.nato.int/cps/en/natohq/official_texts_185174.htm
28. 2021: *Department of Defense Climate Risk Analysis 2021.* The analysis is a key step in the process of integrating this aspect into strategic planning. Online: https://media.defense.gov/2021/Oct/21/2002877353/-1/-1/0/DOD-CLIMATE-RISK-ANALYSIS-FINAL.PDF
29. 2021: *Climate Change and International Responses Increasing Challenges to US National Security Through 2040.* NIC-NIE-2021-10030-A. Online: https://www.dni.gov/files/ODNI/documents/assessments/NIE_Climate_Change_and_National_Security.pdf
30. 2021: *Department of Defense Climate Adaptation Plan.* The document sets out the principles for ensuring the nation's defence needs and the concepts for maintaining the army's readiness and resilience in the face of challenges posed by climate change. Online: https://media.defense.gov/2021/Oct/07/2002869699/-1/-1/0/DEPARTMENT-OF-DEFENSE-CLIMATE-ADAPTATION-PLAN.PDF
31. 2021: *WMO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970–2019).* The report provides detailed data on the most devastating natural disasters at global and regional

level. It classifies disasters into two categories: the 10 most damaging disasters in each category, in terms of deaths and economic losses. Online: https://library.wmo.int/doc_num.php?explnum_id=10902

32. 2021: *Climate Change 2021. The Physical Science Basis.* The report is unique in that it also focuses on regional changes. It is scientifically rigorous, based on a review of 14,000 scientific publications. The analysis consists of three parts, the first of which was published now, covering the physical science basis and examining the causes of climate change, the current situation and what can be expected in the future. Online: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report.pdf

Annex II

Table A1. *The 10 most deadly natural disasters on Earth between 1970 and 2019*

	Type	*Year*	*Country*	*Number of casualties*
1	Drought	1983	Ethiopia	300,000
2	Storm (Bhola)	1970	Bangladesh	300,000
3	Drought	1983	Sudan	150,000
4	Storm (Gorky)	1991	Bangladesh	138,866
5	Storm (Nargis)	2008	Myanmar	138,366
6	Drought	1973	Ethiopia	100,000
7	Drought	1981	Mozambique	100,000
8	Extreme heatwave	2010	Russian Federation	55,736
9	Flood	1999	Bolivarian Republic of Venezuela	30,000
10	Flood	1974	Bangladesh	28,700

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 18

Table A2. *Top 10 natural disasters causing the largest economic loss on Earth 1970–2019*

	Type	*Year*	*Country*	*Economic loss (billion USD)*
1	Storm (Katrina)	2005	United States	163.61
2	Storm (Harvey)	2017	United States	96.94
3	Storm (Maria)	2017	United States	69.39
4	Storm (Irma)	2017	United States	58.16
5	Storm (Sandy)	2012	United States	54.47
6	Storm (Andrew)	1992	United States	48.27
7	Flood	1998	China	47.02
8	Flood	2011	Thailand	45.46
9	Storm (Ike)	2008	United States	35.63
10	Flood	1995	Democratic People's Republic of Korea	25.17

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 18

Table A3. *The 10 most deadly natural disasters in Africa between 1970 and 2019*

	Type	*Year*	*Country*	*Number of casualties*
1	Drought	1983	Ethiopia	300,000
2	Drought	1983	Sudan	150,000
3	Drought	1973	Ethiopia	100,000
4	Drought	1981	Mozambique	100,000
5	Drought	2010	Somalia	20,000
6	Drought	1973	Somalia	19,000
7	Drought	1980	Chad	3,000
8	Flood	1997	Somalia	2,311
9	Landslide	2017	Sierra Leone	1,102
10	Flood	2001	Algeria	921

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 23

Table A4. *Top 10 natural disasters causing the largest economic loss in Africa 1970–2019*

	Type	*Year*	*Country*	*Economic loss (billion USD)*
1	Drought	1990	South Africa	1.96
2	Storm (Idai)	2019	Mozambique	1.96
3	Flood	1987	South Africa	1.72
4	Storm (Emilie)	1977	Madagascar	1.48
5	Drought	2015	Ethiopia	1.48
6	Drought	1999	Morocco	1.38
7	Drought	1976	Senegal	1.35
8	Drought	2017	South Africa	1.22
9	Storm (Gervaise)	1975	Mauritius	0.95
10	Flood	2011	Algeria	0.89

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 23

Table A5. *The 10 most deadly natural disasters in Asia between 1970 and 2019*

	Type	*Year*	*Country*	*Number of casualties*
1	Storm (Bhola)	1970	Bangladesh	300,000
2	Storm (Gorky)	1991	Bangladesh	138,866
3	Storm (Nargis)	2008	Mianmar	138,366
4	Flood	1974	Bangladesh	28,700
5	Flood	1975	China	20,000
6	Storm	1985	Bangladesh	15,000
7	Storm	1977	India	14,204
8	Storm	1999	India	9,843
9	Storm	1971	India	9,658
10	Flood	1980	China	6,200

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 29

Table A6. *Top 10 natural disasters causing the largest economic loss in Asia 19*

	Type	*Year*	*Country*	*Economic loss (billion USD)*
1	Flood	1998	China	47.02
2	Flood	2011	Thailand	44.45
3	Flood	1995	Democratic People's Republic of Korea	25.17
4	Extreme temperatures	2008	China	25.06
5	Drought	1994	China	23.72
6	Flood	2016	China	22.92
7	Flood	2010	China	21.10
8	Flood	1996	China	20.52
9	Storm (Mireille)	1991	Japan	18.76
10	Flood	2014	India	16.90

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 29

Table A7. *The 10 most deadly natural disasters in South America between 1970 and 2019*

	Type	*Year*	*Country*	*Number of casualties*
1	Flood	1999	Bolivarian Republic of Venezuela	30,000
2	Flood	2011	Brazil	900
3	Landslide	1987	Colombia	640
4	Landslide	1971	Peru	600
5	Storm	1997	Peru	518
6	Extreme temperatures	2014	Peru	505
7	Landslide	1973	Peru	500
8	Flood	2010	Colombia	418
9	Extreme temperatures	2010	Peru	409
10	Landslide	1983	Peru	364

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 35

Table A8. *Top 10 natural disasters causing the largest economic loss in South America 1970–2019*

	Type	*Year*	*Country*	*Economic loss (billion USD)*
1	Drought	1978	Brazil	9.02
2	Drought	2014	Brazil	5.28
3	Flood	1999	Bolivarian Republic of Venezuela	4.85
4	Drought	2018	Argentina	3.40
5	Flood	2017	Peru	3.16
6	Flood	1985	Argentina	3.09
7	Extreme temperatures	1975	Brazil	2.84
8	Flood	1983	Argentina	2.56
9	Landslide	1983	Peru	2.54
10	Flood	1984	Brazil	2.46

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 35

Table A9. *The 10 most deadly natural disasters in North and Central America between 1970 and 2019*

	Type	*Year*	*Country*	*Number of casualties*
1	Storm (Mitch)	1998	Honduras	14,600
2	Storm (Fifi)	1974	Honduras	8,000
3	Storm (Mitch)	1998	Nicaragua	3,332
4	Land slide	1973	Honduras	2,800
5	Storm (Jeanne)	2004	Haiti	2,754
6	Flood	2004	Haiti	2,665
7	Storm (Katrina)	2005	United States	1,833
8	Storm (Stan)	2005	Guatemala	1,513
9	Storm	1979	Dominican Republic	1,400
10	Extreme temperatures	1980	United States	1,260

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 41

Table A10. *Top 10 natural disasters causing the largest economic loss in North and Central America between 1970 and 2019*

	Type	*Year*	*Country*	*Economic loss (billion USD)*
1	Storm (Katrina)	2005	United States	163.61
2	Storm (Harvey)	2017	United States	96.94
3	Storm (Maria)	2017	Puerto Rico	69.39
4	Storm (Irma)	2017	United States	58.16
5	Storm (Sandy)	2012	United States	54.47
6	Storm (Andrew)	1992	United States	48.27
7	Storm (Ike)	2008	United States	35.63
8	Fire	2019	United States	24.46
9	Storm (Ivan)	2004	United States	24.36
10	Drought	2012	United States	21.79

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 41

Table A11. *The 10 most deadly natural disasters Southwest Oceania between 1970 and 2019*

	Type	*Year*	*Country*	*Number of casualties*
1	Storm (Haiyan)	2013	Philippines	7,354
2	Storm (Thelma)	1991	Philippines	5,956
3	Storm (Bopha)	2012	Philippines	1,901
4	Storm	1973	Indonesia	1,650
5	Storm (Winnie)	2004	Philippines	1,619
6	Storm (Joan and Kate)	1970	Philippines	1,551
7	Storm (Washi)	2011	Philippines	1,439
8	Storm (Ike)	1984	Philippines	1,399
9	Storm (Durian)	2006	Philippines	1,399
10	Land slide	2006	Philippines	1,126

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 49

Table A12. *Top 10 natural disasters causing the largest economic loss in Southwest Oceania 1970–2019*

	Type	*Year*	*Country*	*Economic loss (billion USD)*
1	Drought	1981	Australia	16.85
2	Fire	1997	Indonesia	12.74
3	Storm (Iniki)	2013	Philippines	10.74
4	Flood	2010	Australia	8.56
5	Storm (Tracy)	1974	Australia	4.15
6	Storm (Alby)	1978	Australia	3.92
7	Flood	2013	Indonesia	3.22
8	Drought	2002	Australia	2.84
9	Storm	2011	Australia	2.84
10	Storm	2017	Australia	2.76

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 49

Table A13. *The 10 most deadly natural disasters in Europe between 1970 and 2019*

	Type	*Year*	*Country*	*Number of casualties*
1	Extreme temperature	2010	Russian Federation	55,736
2	Extreme temperature	2003	Italy	20,089
3	Extreme temperature	2003	France	19,490
4	Extreme temperature	2003	Spain	15,090
5	Extreme temperature	2003	Germany	9,355
6	Extreme temperature	2015	France	3,275
7	Extreme temperature	2003	Portugal	2,696
8	Extreme temperature	2006	France	1,388
9	Extreme temperature	2003	Belgium	1,175
10	Extreme temperature	2003	Switzerland	1,039

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 55

Table A14. *Top 10 natural disasters causing the largest economic loss in Europe 1970–2019*

	Type	*Year*	*Country*	*Economic loss (billion USD)*
1	Flood	2002	Germany	16.45
2	Flood	1994	Italy	16.03
3	Flood	2013	Germany	13.86
4	Wind storm	1999	France	12.27
5	Flood	2000	Italy	11.87
6	Flood	1983	Spain	10.00
7	Drought	1990	Spain	8.81
8	Flood	2000	United Kingdom	8.75
9	Storm	2007	Spain	6.78
10	Storm	1990	United Kingdom	6.65

Source: Prepared by the author on the basis of data from World Meteorological Organization 2021: 55

Annex III

Overview of Selected Strategic River Basins

River	*Issues*	*Effect*	*Quality of water management*
Indus	Poor water management; inefficient agricultural practices; soil salinization; inadequate infrastructure; greater variability in water availability; water pollution	Degraded regional food security–present to 2040; reduced resiliency to floods and droughts–present to 2040	Moderate
Jordan	Depleted shared groundwater resources; greater variability in water available; water pollution; poor coordination between countries	Reduced resiliency to floods and drought–present to 2040; degraded regional food security– present to 2040; continuing regional tensions over water–present to 2040	Moderate
Mekong	Increased development and demands; greater variability in water available; changes in sediment flows	Reduced regional food security (to include fisheries) and negative impact on livelihoods–present to 2040; reduced resiliency to floods and droughts–present to 2040; increased regional tension over water development activity–present to 2040	Limited
Nile	Decreasing per capita water available; inadequate water agreements and management structure; greater variability in water available; water flow impeded as new dam reservoirs are filled; delta erosion	Degraded food security–present to 2040; reduced resiliency to floods and droughts–present to 2040; increased regional tensions over water and use of water as leverage–present to 2040	Limited

River	*Issues*	*Effect*	*Quality of water management*
Tigris and Euphrates	No multilateral water-sharing agreement; increased variability in water supply; reduced water flow near-term; altered sediment flows to downstream agricultural and marshlands	Reduced resiliency to floods and droughts–present to 2040; reduced regional food security–present to 2040; continued regional tensions over unilateral water development projects and management–present to 2040	Limited
Amu Darya	Inadequate water agreements; degradation of water quality and disruption of flows in some states; poor water management	Degraded regional food security–present to 2040; increased regional tensions over water–present to 2040; decreased health of populations around dried Aral Sea	Inadequate
Brahmaputra	Uncoordinated land use and development plans; insufficient water agreements; reduced water flows; saltwater intrusion into the delta	Continuing regional tensions over unilateral water development projects–present to 2040; reduced potential for hydropower generation in some states–2020 to 2040; reduced regional food security, especially fisheries–present to 2040	Inadequate

Source: Compiled by the author based on data from US Office of the Director of National Intelligence 2012

This volume explores the impact of climate change on national security and military strategies, providing an in-depth analysis of natural disaster control and the (increasing) role of the armed forces in it worldwide. It delves into the impact of weather on military operations, as changes in weather patterns and extreme events can fundamentally disrupt the plans of military leaders.

The declared purpose of writing this book is to enable the planners of the ambitious *Defence and Military Development Programme* underway in our country to rely on the information gathered and consider the challenges posed by a changing climate in their decisions, whether related to human resources, military technology development, procurement, training, education, or preparation.

This English edition builds upon the Hungarian original, introducing new features that present the latest opinions, positions and events.

ISBN 978-963-653-067-9