Adapting to Climate Change: Lessons for Swiss Civil Protection

Report

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Adapting to Climate Change: Lessons for Swiss Civil Protection

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Executive Summary

Context

From extensive heat waves, drought, critical water shortage, and forest fires, to devastating floods, climate-exacerbated hazards have left an indelible mark on Europe in recent years. A number of high-level policies and strategies for adapting to climate change have been in place since the 2000s in Europe, which are linked to international agreements, such as the Paris Agreement and the Sendai Framework for Disaster Risk Reduction. Switzerland has had a national climate change adaptation strategy in place since 2012. While Switzerland has implemented some and acknowledged other necessary climate adaptation measures, it is clear from the increasing frequency, intensity, and scale of climate-exacerbated hazards in Europe that more adaptation and better cooperation across cantonal and international borders are needed.

Objective

This CSS Risk and Resilience Report was commissioned by the Swiss Federal Office for Civil Protection (FOCP) with the aim to complement an existing 2021 analysis by the FOCP, which outlined action points and predicted incident management needs until 2040 in response to climate change. The CSS Report assists the ongoing efforts by the FOCP to assess the capabilities required to cope with climate-exacerbated hazards in Switzerland. In particular, the report identifies opportunities for Swiss Civil Protection through an analysis of structural and procedural changes initiated or implemented by Germany, Austria, France, and Italy in response to recent disasters.

Method

The Report is based on desk-based research of secondary sources, and semi-structured interviews conducted between August 2022 and March 2023 with key representatives from national administrations dealing with civil protection and/or the environment. It is structured into three sections, starting with an introduction in Section 1. Section 2 provides a broad overview of the civil protection structures, processes, and responsibilities in Switzerland, Germany, Austria, France, and Italy respectively, to provide context for the structural and procedural reforms discussed in the next section. Section 3 presents the findings for the four country case studies. Section 4 concludes the report by outlining the opportunities and lessons highlighted by the study, which can assist Swiss Civil Protection's efforts to adapt to a changing climate.

Results

Recent climate-exacerbated hazards and consequent flooding, drought, and forest fires have led to tangible changes within the civil protection systems of the countries analyzed in this study. In Germany, a wave of reforms is gradually being rolled out across civil protection policy and practice in response to the disastrous 2021 floods; changes already evident in the response to more recent forest fires. In Austria, the lessons learnt from the 2021 forest fires aligned with policy changes already in train, enabling the timely release of a strategic forest fire action program as well as practical changes that enhance Austria's capacity to manage and respond to forest fires. In France, the climate shocks experienced during 2022 made it painfully clear how the scale and frequency of known hazards have increased, resulting in a need for more resources and personnel that are now being procured, trained, and deployed. In Italy, a recent political change is resulting in structural changes, but overall its civil protection system has been thoroughly tried and tested over time, and no major changes in response to recent events had therefore been considered necessary at the time of this study.

Two particular lessons apply to all four countries. First, the study demonstrated the important role the European Union Civil Protection Mechanism (UCPM) plays in enabling timely forecasting and knowledge exchange, and as an invaluable back-up when climate-exacerbated hazards overwhelm national resource allocation and response capacities. The study also pointed to the critical need to continually assess and adapt the UCPM's capacities, outreach, and structural set-up in response to the increasing frequency, scale, and intensity of climate-exacerbated hazards across the European continent. Second, the study highlighted a troublesome gap between the moment when awareness of a problem emerges due to monitoring of trends, and the moment when adaptation measures are in place to respond to the changing conditions. Acknowledgment of this gap is particularly relevant for Switzerland in its current strategic quest to adapt its civil protection system and boost societal awareness of climate-exacerbated hazards before the toll of regular heatwaves, drought, water scarcity, flooding, and forest fires also become acute in Switzerland with climate change.

In response to these findings, the Report identifies eight particular pathways that can assist Swiss Civil Protection to adapt to climate-exacerbated hazards:

- Linking national strategies and action plans.
- Deepening vertical and horizontal integration.
- Fostering knowledge sharing.
- Expanding trans-regional and international cooperation.
- Regionalization of capacities.
- Adapting and enhancing resources and capabilities.
- Improving public preparedness and coping capacity.
- Optimizing situational awareness and crisis communication.

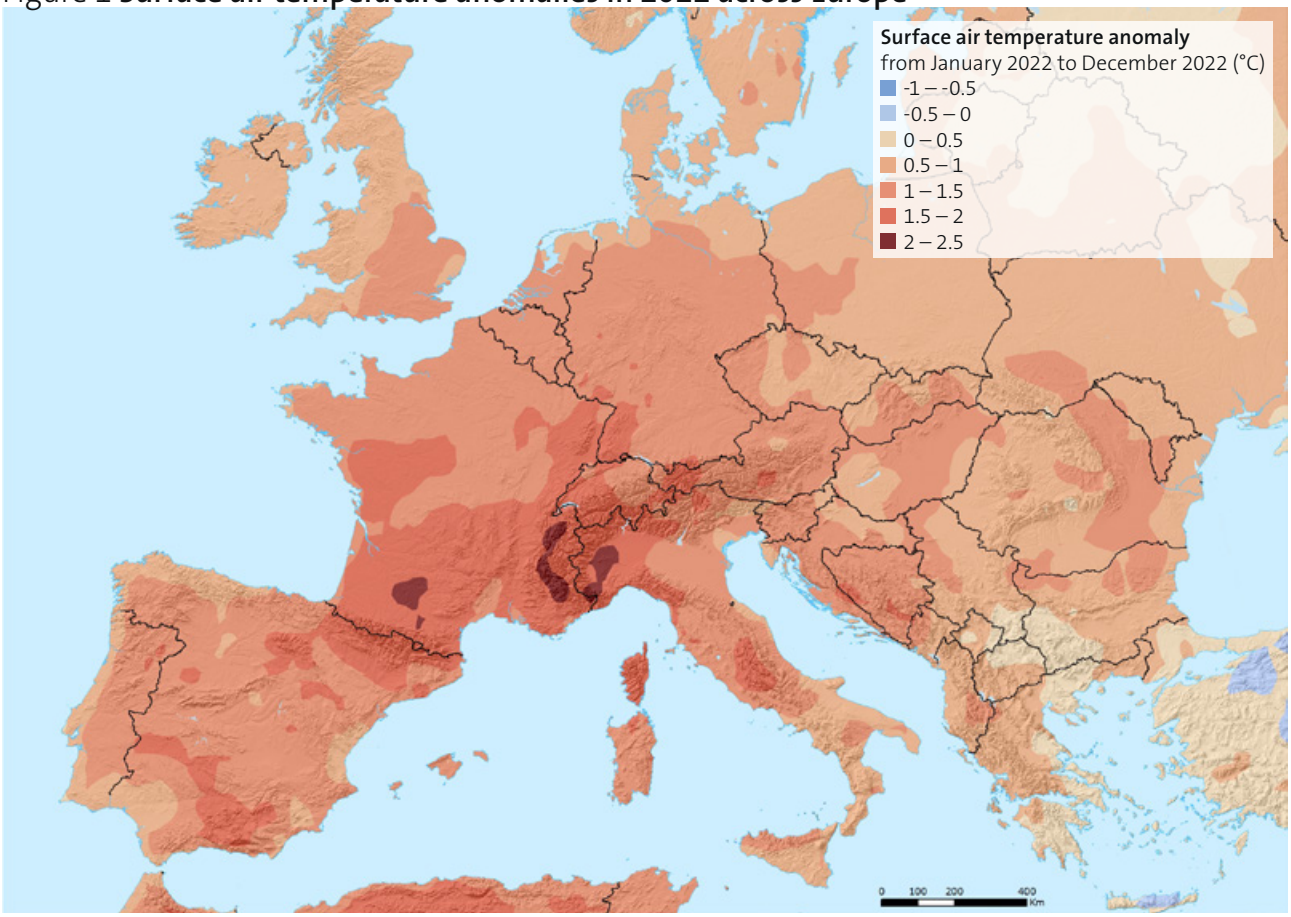
1 Introduction

From extensive heat waves, drought, critical water shortage, and forest fires, to devastating floods, climate-exacerbated hazards have left an indelible mark on Europe in recent years. One of the root causes propelling the frequency and intensity of climate-related hazards is global warming (see Figures 1 and 2). The summer of 2021 was the warmest ever recorded in Europe,[1] a record promptly surpassed by the European heatwave in July and August 2022.[2] Both summers were also among the worst forest fire seasons on record in terms of the number of fires and the total area burnt.[3,4,5] They are part of a global warming trend in which Europe has warmed almost twice the global average in the last three decades (+2.2˚C compared with +1.2˚C globally).[6,7] High-elevation regions, such as the Alps, are particularly vulnerable to climate change, as they warm faster than lower elevations due, in part, to landlocked regions heating up faster than coastal areas that benefit from the cooling influence of the sea.[8] Observed changes that are direct flow-on effects of higher temperatures include changing seasonal weather patterns and more extreme weather events.[9]

In Switzerland, the annual average temperature has increased by 2˚C Celsius since the pre-industrial era. Without concerted efforts to mitigate greenhouse gas emissions, a further increase in the annual average temperature of 2–3˚C is possible by 2060,[10] with significant consequences for natural hazard management and everyday life.[11,12] Such predictions mean summers with more frequent and extreme heat waves and hot days, and days that are on average up to 4.5˚C warmer than today. Summer months will also have less precipitation on average, with fewer rainy days and more evaporation leading to drier soils and waterbodies. However, warmer air can absorb more moisture, which is one of the reasons extreme precipitation events will be more extreme and frequent in all seasons. Winter months will be up to 3.5˚C warmer on average than today, with the zero-degree temperature line being up to 650 meters higher. Less snow, retreating glaciers, and permafrost thaw will significantly alter terrain stability and the availability and flow of water in watersheds, rivers, lakes, and reservoirs.

The last two summers have also demonstrated how climate change interacts with broader geographical, demographic, political, and socioeconomic changes in Eu-

Figure 1 **Surface air temperature anomalies in 2022 across Europe**



Source Data: Copernicus Climate Change Service/ECMWF

rope to create a cascading set of consequences that threaten lives, livelihoods, infrastructures, and assets.[13,14] For many Europeans, climate change is suddenly no longer an abstract concept but a felt reality – from smoke-filled air, unbearable heat, and empty water taps, to evacuations and catastrophic losses. This reality comes with a daunting realization: Human-induced climate change can no longer be reversed. Yet, if society acts now, mitigation and adaptation measures can significantly stem the impact and increase the capacity of society to cope.[15] This includes the ability of civil protection systems and associated organizations to prepare and respond at local, municipal, national, and international levels.[16,17]

A number of high-level policies and strategies for adapting to climate change have been in place since the 2000s in Europe. At an international level, the 2009 EU White Paper Adapting to Climate Change: Towards a European Framework for Action[18] gradually evolved into the 2013 and 2021 EU Strategies on Adapting to Climate Change.[19,20] The overall aim is to build climate-resilient futures in Europe by enabling smarter and more systemic risk assessment and capacity planning, and through faster implementation of adaptation solutions. The current strategy is supported by the European Green Deal[21] and linked to international agreements, such as the Paris Agreement,[22] the Sendai Framework for Disaster Risk Reduction,[23] and the Mission for a Climate Resilient Europe.[24] On a national level, Switzerland has had a national climate change adaptation strategy in place since 2012,[25] with a two-part action plan spanning 2014–2019 and 2020–2025 respectively.[26,27] Switzerland's neighboring countries have similar national strategies in place to provide conceptual guidance, predictions, and visions for how to adapt their respective socio-economic structures and ecosystems to climate change.[28,29,30,31] These national strategies are implemented according to various national action plans or sectorial adaptation plans, and progress is reviewed regularly.[32]

Climate-exacerbated hazards is but one of many concerns considered in these climate change adaptation strategies. National risk analyses therefore exist to provide more specific insights to civil protection agencies, such as risk identification and monitoring of how risks evolve over time. There is significant variability in how individual countries in Europe prioritize risks, and the methods used to assess these risks (for example, see the details provided by Germany[33], Austria[34], France[35], and Italy[36]).[37] The EU has facilitated a process since 2009, which aims to streamline Member States' various approaches, and to make the resultant national risk analyses more comparable.[38] Two guidelines by the European Commission outline recommendations and best practices, drawing on the International Organization of Standardization 31000 Risk Management Standard (ISO 31000).[39] All Member States are required to produce a risk analysis every three years, the results of which are aggregated and published by the Commission.[40] It provides an overview of common risks in Europe, and informs the planning of joint actions and investments, for example, to increase the capacities of the UCPM in response to climate-exacerbated hazards.

Underpinning these adaptation strategies and risk analyses is the fundamental fact that civil protection, disaster management, and climate change adaptation are inherently dynamic tasks. Furthermore, the propensity of natural hazards to expose social vulnerability has over time been a driver of structural and procedural change.[41] This applies to Switzerland too. The catastrophic floods in Switzerland in August 2005, for example, created sufficient momentum for the Federal Council to improve hazard monitoring, forecasting, and alerts, and to strengthen coordination via a new "natural hazards crisis committee".[42] Switzerland published its first National Risk Analysis Report in 2013 (with subsequent periodic updates), which now forms the basis for preparedness, prevention, and response measures at all levels of government.[43] Each of the 44 natural, technological, and social hazards identified in the current edition (2020)[44] are accompanied by concrete scenarios, estimated probability of occurrence, and detailed analysis of possible impacts.

While Switzerland has implemented (e.g., flood prevention) or acknowledged (e.g., forest firefighting)[45] necessary climatechange adaptation measures, it is clear from the increasing frequency, intensity, and scale of climate-exacerbated hazards in Europe that more adaptation measures and better cooperation across cantonal and international borders are needed (see Table 1). In a 2021 analysis, a collaborative study by the Federal Office for Civil Protection (FOCP) outlined action points and predicted incident management needs until 2040 due to the impact of climate change.[46]

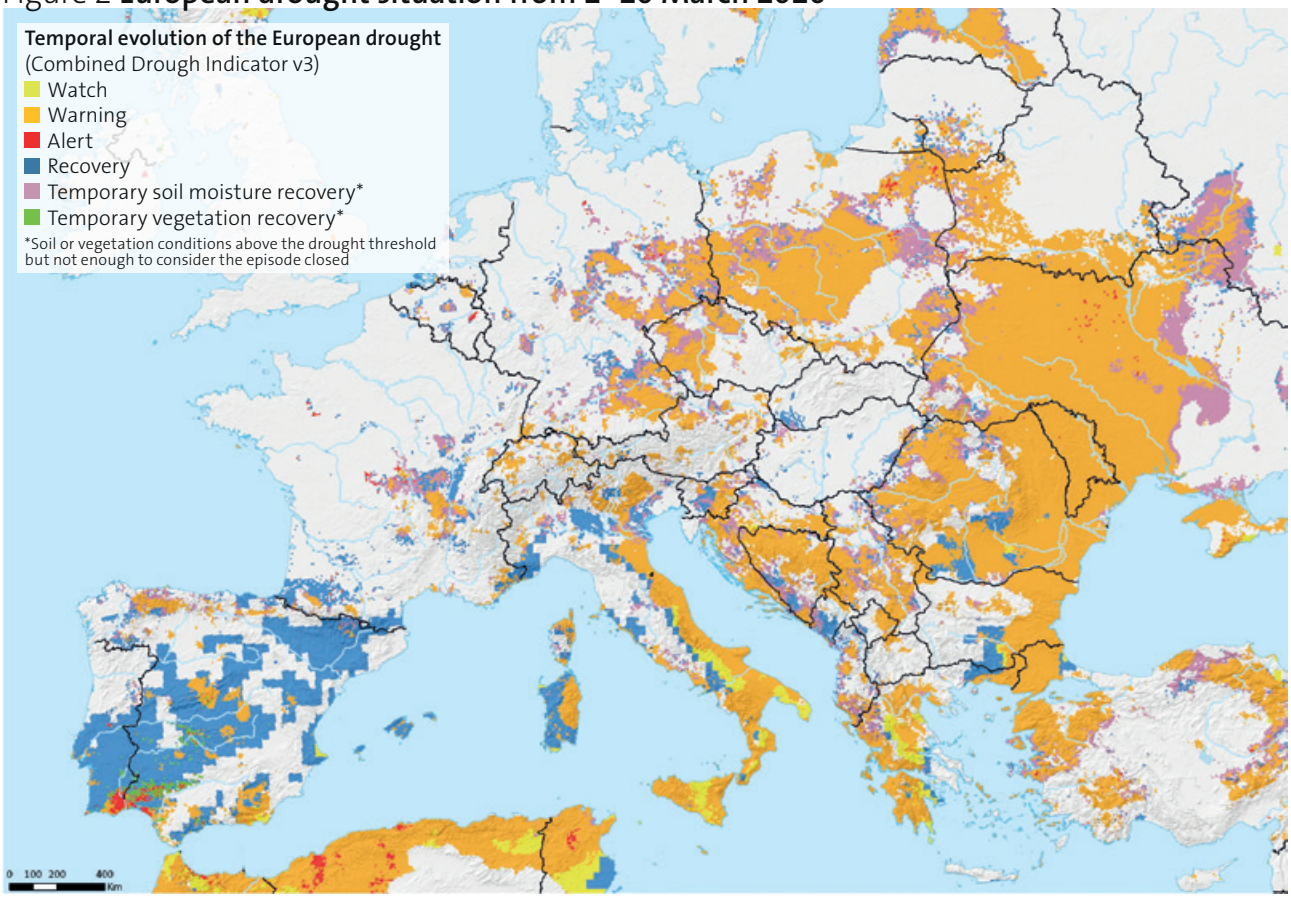
Table 1 **Annual number of severe weather events for each of the case study countries**

Country	2007	2012	2017	2022
Switzerland	26	125	98	922
Germany	849	2219	4253	5575
Austria	148	888	497	841
France	180	526	5224	4653
Italy	91	481	614	3191

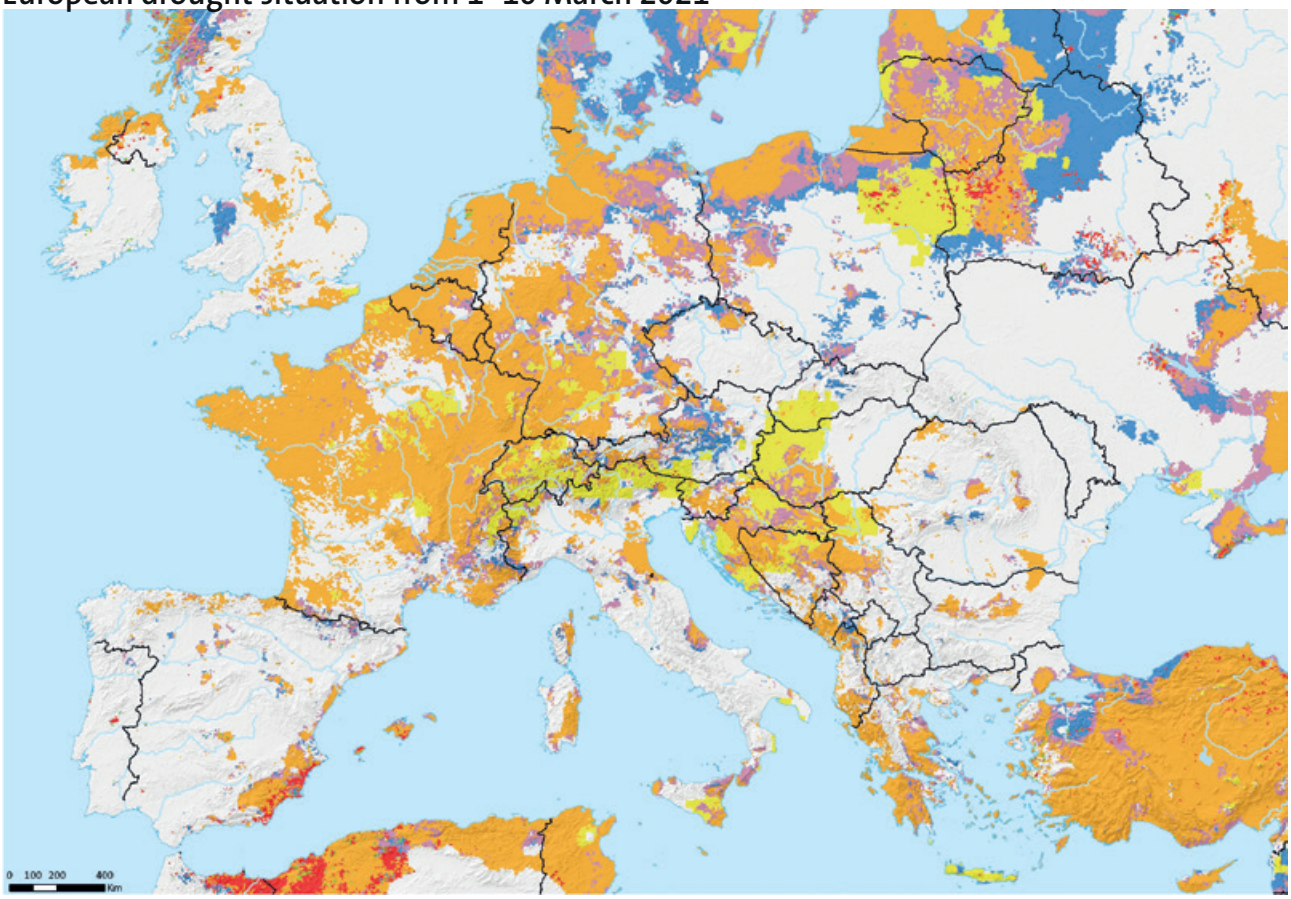
Data retrieved from the European Severe Weather Database, 5 April 2023, https://eswd.eu/cgi-bin/eswd.cgi.
Data includes: records of dust, sand- or steam devils; gustnadoes; large hail; heavy rain; tornadoes; severe wind gusts; heavy snowfalls/snowstorms; ice accumulations; avalanches; damaging lighting strikes.

This CSS Risk and Resilience Report was commissioned by the FOCP with the aim to complement the above mentioned resources, and to assist current efforts by the FOCP to assess the capabilities required to cope with climate-related hazards in Switzerland.[47] In particular, the report identifies opportunities for Swiss Civil Protection through an analysis of structural and procedural changes initiated or implemented by Germany, Austria, France, and Italy in response to recent climate-exacerbated hazards or disasters. This analysis is based on desk-based research of secondary sources as well as semi-structured interviews conducted between August 2022 and March 2023 with key representatives from the national administrations dealing with civil protection and/or the environment. The remainder of the report is structured into three sections. Section 2 provides a broad overview of the civil protection structures, processes, and responsibilities in Switzerland, Germany, Austria, France, and Italy respectively, to provide context for the structural and procedural reforms discussed in the next section. Section 3 presents the findings for the four country case studies. Section 4 concludes the report by outlining the opportunities and lessons highlighted by the study, which can assist Swiss Civil Protection's efforts to adapt to a changing climate.

Figure 2 **European drought situation from 1–10 March 2020**

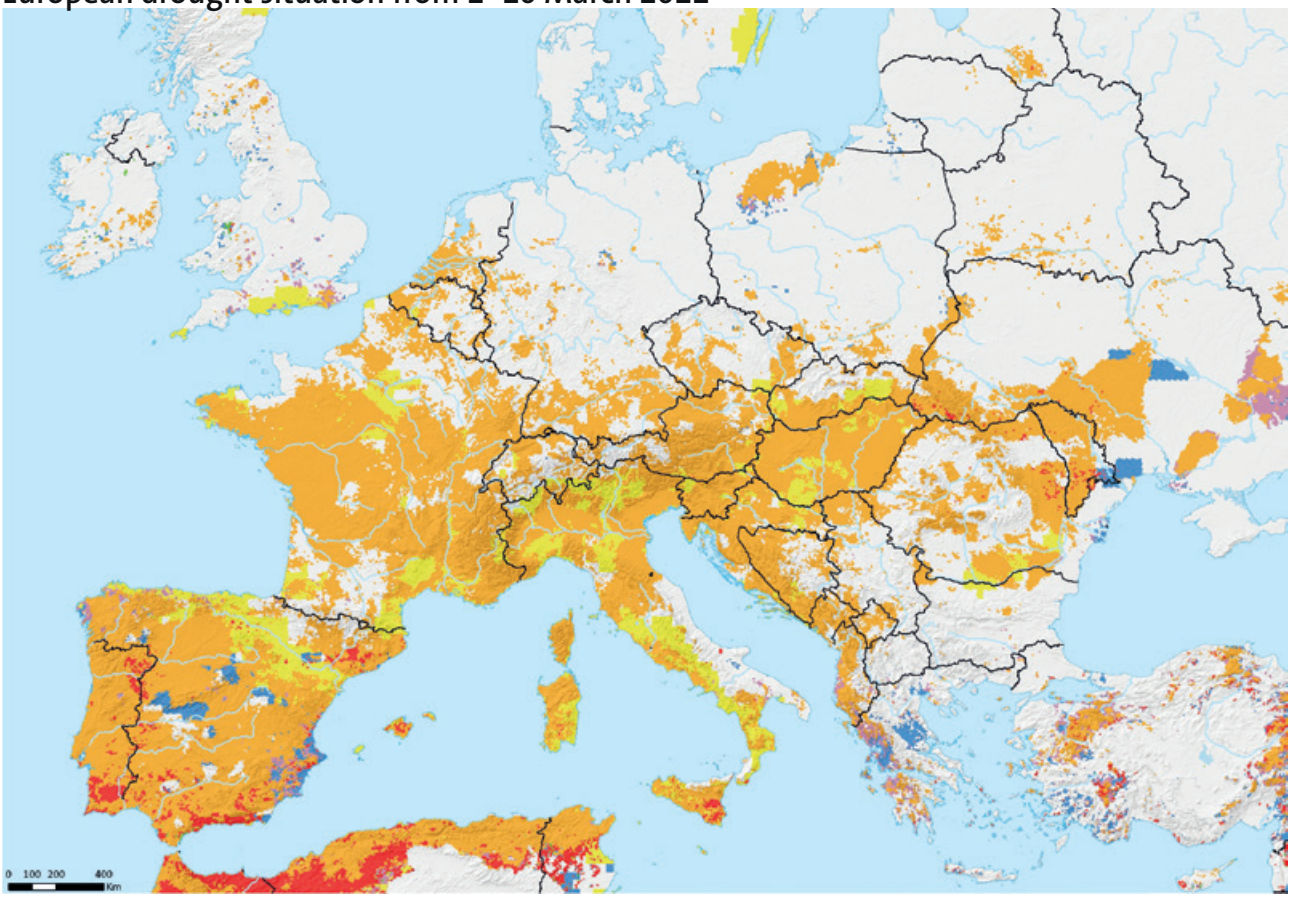


European drought situation from 1–10 March 2021

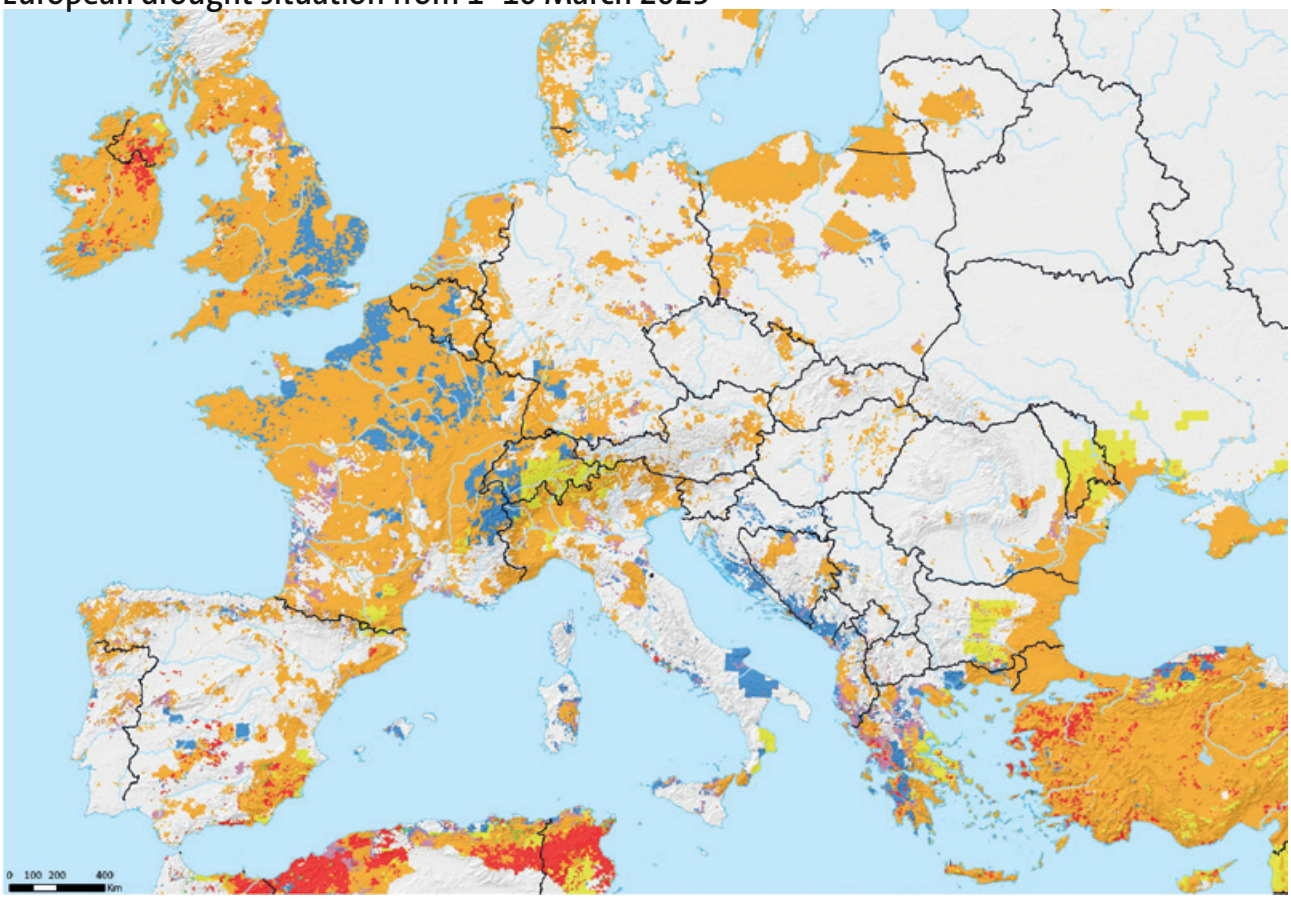


Source Data: JRC-EDO CDI v3

European drought situation from 1–10 March 2022



European drought situation from 1–10 March 2023



2 Overview of Civil Protection Structures

2.1 Switzerland

The current mandate of Swiss Civil Protection is "to protect the population and its livelihoods in the event of major incidents, disasters, emergencies and armed conflicts, to contribute to the limitation and management of incidents and to take appropriate precautionary measures".[48] Since the end of the Cold War, Swiss Civil Protection has primarily focused its activities on the prevention, mitigation, and management of emergencies and disasters due to natural, technological, and societal risks, rather than on the support function in armed conflicts. However, as a consequence of Russia's invasion of Ukraine in February 2022, Swiss Civil Protection was instructed to give renewed attention to the potential impact of future armed conflicts on its tasks.[49]

Swiss Civil Protection is organized as an integrated system *(Verbundssystem)* that brings together the five partner organizations: police, fire service, healthcare, technical services, and *Zivilschutz*.[50] The proportion of professional/paid staff to volunteers within these organizations varies greatly from one organization to another.[51] The structuring of Swiss Civil Protection reflects the structures of Switzerland's federal state, with responsibilities and tasks distributed across all three levels of government: municipal, cantonal, and federal. The 26 cantons and their municipalities are responsible for the establishment, organization, and operational readiness of the partner organizations on their territory. The partner organizations manage everyday events alone or in co-operation with other partner organizations. If several partner organizations are deployed for a civil protection-relevant event for a longer period, the leadership passes from the partner organizations to the municipal, regional, or cantonal command-and-control bodies in civil protection. If a canton cannot cope with an event, it can request subsidiary support from neighboring cantons or the federal government. The latter can involve military or civilian/private resources. Disasters and emergencies affecting more than one canton are managed between the cantons, with each canton overseeing its own resources. As the highest level of crisis management in Switzerland, the Federal Council can assume leadership in civil protection-related disasters and emergencies that impact several cantons simultaneously, the whole of Switzerland, or cross-border with neighboring countries. The Federal Council is then supported by the Federal Civil Protection Crisis Management Board *(Bundesstab Bevölkerungsschutz)* where all relevant federal offices, the cantons, and the operators of critical infrastructure are represented.

While the FOCP is the central actor in civil protection matters at the federal level, it primarily serves in a coordinating role at the federal level and between the cantons and partner organizations, due to the cantons being responsible for most operational tasks and capabilities. The FOCP plans and coordinates protective, rescue, and support measures as well as trainings.[52] It develops the national civil protection strategy, prepares the national risk analysis, and is responsible for the protection of cultural property and the implementation of the national strategy on critical infrastructure protection. It also distributes alerts in the event of immediate danger, and instructs the population during emergencies. To this end, the FOCP operates the National Emergency Operations Centre (NEOC), which monitors and analyses situations around the clock.[53] In an incident, the NEOC alerts relevant actors at federal and cantonal level, and supports the involved command-and-control bodies with a continuously updated electronic situation report.

External organizations and authorities also form a part of the integrated system, providing support with operational resources. In particular, the Swiss Armed Forces can provide subsidiary support to the cantonal authorities, for example, to protect critical infrastructure or with general support measures, such as aerial transport.[54]

At an international level, Switzerland has bilateral disaster relief agreements with all of its five neighboring countries, which provide the legal basis for mutual assistance in the event of a major incident via cross-border cooperation, joint preparedness measures like training exercises, and the integration of cross-border emergency services. Switzerland also signed an Administrative Arrangement with the EU's Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG ECHO) in 2017, which provides a framework for dialogue and coordination at a technical level. However, this Arrangement does not enable Switzerland to benefit from the core operational, coordination, communication, training, and network services of the UCPM. This would require Switzerland to become a fee-paying Participating State of the UCPM – a recommendation currently put forward in sectoral strategy papers as well as in an approved motion in parliament.[55,56]

2.2 Germany, Austria, France, Italy

Civil protection organizations in Germany, Austria, France, and Italy tackle similar issues within their respective geographical borders. Nevertheless, their structures, processes, and responsibilities differ in important ways. These differences are in part due to distinct political systems,

administrative cultures, and direct experiences with major crises and hazards.[57] The following subsections briefly describe the civil protection structures, processes, and responsibilities in each of these four countries to provide context for the structural and procedural reforms described in Section 3 of this report.

A note on linguistic distinctions: Switzerland, Germany, and Austria all use the terminology *Bevölkerungsschutz* (civil protection), *Zivilschutz* (civil defence), and *Katastrophenschutz* (disaster protection). However, in each country the terminology refers to different tasks or organizations. For ease of understanding, this report uses the umbrella term "civil protection" as it is used in Switzerland to refer to the integrated civil protection system *(Bevölkerungsschutz),* and the term *Zivilschutz* to refer to the distinct Swiss organization (see Section 2.1). Only when explaining the individual countries' civil protection structures, processes, and responsibilities in the following subsections, do we explain (and refer to) the distinct meanings as used in the German and Austrian contexts.

Germany

Germany distinguishes between *Katastrophenschutz* and *Zivilschutz*. The latter includes all non-military measures to protect the population in the event of war. *Katastrophenschutz* deals with all measures to protect against major accidents and disasters in peacetimes due to natural, technological, and social hazards. Together, they form an integrated system. Thus, civil protection in Germany covers all non-police and civil tasks to protect the population from major accidents and disasters.[58] The structures, processes, and responsibilities in this system reflect the country's federal political system and are based on the principle of subsidiarity, with strong bottom-up arrangements.

Relevant tasks and responsibilities for *Katastrophenschutz* are distributed across all governmental levels (municipalities / districts, States *(Bundesländer),* Federation). The federal government provides the legal framework for civil protection and is responsible for *Zivilschutz.* The States regulate responsibility for *Katastrophenschutz* tasks through their respective legislation. Municipalities are generally responsible for day-to-day emergency response (although there are some regional differences), such as firefighting.[59] The districts and independent cities *(kreisfreie Städte)* are responsible for rescue services and *Katastrophenschutz.* If regional organizations are unable to cope with a crisis on their own, local or regional governments can request support from the Technical Relief Agency (THW), the Federal Police, or the military.[60] As a result of this structural setup, operational crisis management is largely not managed by the federal government. Instead, cooperation and coordination is required across multiple levels of government in a crisis.[61]

The German Federal Office of Civil Protection and Disaster Assistance (BBK) is the central federal authority in civil protection matters.[62] The BBK functions primarily as a service provider and a reactive coordination platform for lower levels of government and their regional crisis response forces.[63] For example, it hosts and helps to operate the Joint Reporting and Situation Centre (GMLZ) of the Federation and the States, which, among other tasks, facilitates the exchange of crisis information and resource management between the different governmental levels. Local fire brigades, police, emergency medical services, and aid organizations are the first to respond to disasters. Many of these organizations are characterized by a high number of trained volunteers who work alongside professional first responders.

At an international level, Germany has bilateral disaster relief agreements with all of its nine neighboring countries as well as Hungary, Lithuania, and Russia.[64] As an EU Member State, Germany is also an active member of the UCPM, which it has activated five times since 2016, three times for consular assistance and repatriation of EU citizens, and twice in 2022 for forest firefighting and Monkeypox treatment.

Austria

Austria also distinguishes between *Zivilschutz* and *Katastrophenschutz*.[65] *Zivilschutz* includes all measures to protect the population from natural hazards as well as technical, terrorist, or warlike emergencies. *Katastrophenschutz,* in turn, includes all measures taken before a disaster occurs in terms of prevention, mitigation, and preparedness. However, the term civil protection is increasingly used in Austria as an umbrella term for both.

Like Germany, Austria has a federal political system, which is reflected in how civil protection is structured with responsibilities dispersed across all governmental levels (municipalities / districts, States *(Bundesländer),* Federation). Responsibility for disaster response lies with the nine States and their respective municipalities und districts.[66] In most cases, a crisis is managed by mayors or district authorities. However, in a major disaster the government of the impacted State assumes operational control. The disaster relief acts of each State form the legal basis for any operational response, regulating the declaration of a state of disaster, and the operational organization of response at municipal, district, and State levels.[67]

There are exceptions to this chain of command. In a health crisis, a nuclear accident, or a supply chain crisis, an emergency response is always implemented at the national level. A division in the Federal Ministry of the In-

terior is responsible for coordinating national crisis and disaster management, assistance in supra-regional or international crisis management, as well as *Zivilschutz* matters. A national coordinating committee, chaired and managed by the Ministry of the Interior, ensures coordination between the relevant actors in large-scale crisis situations and strategic planning.[68] It brings together federal ministries, States, emergency organizations, and the media. The Ministry of the Interior also operates the Federal Alarm Center that operates 24/7 and functions as a contact point during national, trans-regional, and international crises and disasters.[69] First responders are from emergency services, such as local fire brigades, Red Cross, and mountain rescue. As in Germany, they are mainly staffed by trained volunteers, alongside some professional staff members. If lower governmental levels are unable to cope with a crisis on their own, they can request support from the federal state.

Austria has bilateral disaster relief agreements with all eight neighboring countries, except Italy, and with Croatia, Albania, Moldova, Morocco, and Jordan.[70] Negotiations are ongoing with Azerbaijan, Serbia, Georgia, and Tunisia. Austria has also signed Memorandums of Understanding on bilateral cooperation in disasters with Bosnia and Herzegovina, China, and Russia. As an EU Member State, Austria is also an active member of the UCPM, and it has requested assistance, for example, for the repatriation of EU citizens during the COVID-19 pandemic in 2020, in response to forest fire in 2021, and for Monkeypox treatment in 2022.

France

In France, civil protection *(sécurité civile)* covers measures for risk mitigation, disaster preparedness, and efforts to protect lives, livelihoods, and assets during major accidents and disasters.[71] The structures and processes reflect the French governmental structures, which are more centralized than in a federal state. Mayors are responsible for crisis management within their municipalities. This includes communication with higher-level authorities, public warnings, and local emergency response. In a major crisis, the responsibility for disaster response escalates to the relevant Departmental Prefect, who has an interministerial headquarter and an operational center at their disposal.[72] When a disaster affects more than one Department, the prefect of one of the country's 12 defense and security zones assumes responsibility for mobilizing, coordinating, and distributing resources. Emergency services under the authority of mayors and departmental prefects are usually the first responders in a disaster, and often includes local fire brigades. Of France's approximately 250,000 firefighters, around 80 per cent are trained volunteers, while 20 per cent are military or professional career firefighters.[73]

At a national level, the Directorate-General for Civil Protection and Crisis Management (DGSCGC) within the Ministry of the Interior and Overseas anticipates and monitors civil protection crises in France. If needed, the DGSCGC organizes national crisis management through an Interministerial Crisis Cell and the Interministerial Crisis Management Operations Centre (COGIC), which also serves as an interface between the operational centers of other ministries.[74] The DGSCGC has around 2,500 first responders at its disposal. This includes members of the Military Formations of Civil Security (ForMiSC)[75] who are highly qualified, equipped with specialized equipment, and can be dispatched at any time in both France and abroad.[76] More broadly, the Armed Forces can also provide complimentary resources to boost public services (e.g., logistics, resources, readiness).

France has bilateral agreements for civil protection cooperation and mutual assistance with numerous countries.[77] Traditionally, this was based on bilateral agreements with countries in Western Europe (e.g., Germany, Spain, Italy, Switzerland), in the Maghreb (e.g., Algeria, Morocco, Tunisia) and in French-speaking West Africa (e.g., Côte d'Ivoire, Burkina Faso, Senegal). In recent years, the cooperation has been expanded to Eastern Europe, Latin America, Central Asia, the Middle East, and Asia. As an EU Member State, France is an active member of the UCPM, which it has activated several times in recent years in connection with catastrophic forest fires, marine pollution, the repatriation of EU citizens, and the provision of personal protective equipment during the COVID-19 pandemic.

Italy

Italy's geomorphology makes the country prone to natural hazards. The slow and poorly coordinated response to the disastrous 1980 Campania-Basilicata earthquake paved the way for the establishment of the Department of Civil Protection in 1982, which was later reorganized into the National Civil Protection Service (Law 225/1992 and Legislative decree 1/2018).[78] The National Civil Protection Service is defined as a public utility and refers to a system that comprises all competences and activities aimed at protecting lives, livelihoods, and assets from natural, technological, and social hazards.[79] It includes the forecasting, prevention, and mitigation of risks, as well as emergency management and disaster recovery.

Civil protection in Italy operates as an integrated system across all levels of government: the State, regions, autonomous provinces, and local authorities. It is a complex but flexible structure, which involves a wide range of organizations and actors in its Operational Committee: the National Fire and Rescue Service, the Armed Forces, the Police Forces, the National Health Service, the Italian Red Cross, the organized civil protection volunteer

service, institutions in charge of meteorological services, and the scientific monitoring and research community.[80] The civil protection system follows the principles of vertical subsidiarity and integration when responding to emergencies.[81] Higher levels of government only step in if lower levels of government request assistance.

At the national level, the guiding function of the civil protection system is assigned to the Presidency of the Council of Ministers. Since November 2022, this role has been entrusted to the Minister of Civil Protection and Marine Policies.[82] The Minister sets up the overall political and administrative agenda, and ensures the promotion and coordination of the National Civil Protection Service.[83] To this end, they work with the Department of Civil Protection, whose role concerns the coordination of all technical, operational, and scientific activities. In close cooperation with other levels of government, the Department drafts national plans for risk scenarios and training guidelines, promotes risk prevention activities, and coordinates interventions by the National Civil Protection Service in case of national or international emergencies.[84] The Department also operates the *Sala Situazione Italia* (the "Italian situation room") – a national monitoring and coordination center that is active 24/7 and staffed by representatives from the organizations and actors in the Operational Committee. It identifies emergency situations and distributes alerts to the various emergency components and operational structures.[85] At an intermediate level, regional authorities or autonomous provinces are responsible for implementing civil protection plans that follow a national set of guidelines, and for managing emergencies within their respective administrative regions. On the local level, municipalities are the designated territorial civil protection authorities responsible for managing emergencies that occur within their jurisdiction.[86]

The constitutional principle of subsidiarity is a core value of the Italian civil protection system because it allows for a more efficient and effective response to emergencies.[87] By delegating responsibility to the most local level possible, emergency response can be tailored to the specific needs of the affected community, and resources can be allocated more efficiently. Additionally, by involving local authorities in emergency management, the civil protection system can better integrate existing local infrastructure and resources, which can further enhance the response to emergencies. Only when an emergency affects several administrative entities, and/or requires extraordinary capacities, are higher institutional levels activated through a process of vertical involvement. Emergencies are therefore classified into three types: "type a" (municipal level), "type b" (provincial and regional) and "type c" (national).[88]

"Type a" events, which require the intervention of a single administration, are managed at the municipal level where the mayor is responsible for crisis management with the support of the Municipal Operation Center.[89] If an event exceeds the capabilities of one municipality and/or affects more municipalities, it escalates to a "type b" event, where the Prefect, the Province, or the Region take over crisis management and coordinate response activities. In an emergency of national interest ("type c" event), the Council of Ministers declares a state of emergency, upon proposal by the Prime Minister or the entrusted Minister of Civil Protection and Marine Policies. This frees up funding and special legislation that can speed up emergency response for an identified period of time (up to 12 months, with a possible maximum extension of a further 12 months).[90] In this case, the Department of Civil Protection coordinates the emergency response through the Civil Protection Operational Committee, which brings together all relevant operational actors.[91]

Italy has bilateral disaster relief agreements with most of its neighboring countries, as well as with other European, Mediterranean, and more geographically-distant countries.[92] As an EU Member State, Italy is also an active member of the UCPM, which it has activated several times in recent years in response to catastrophic forest fires, for the repatriation of EU citizens, and the provision of personal protective equipment during the COVID-19 pandemic.

3 Country Case Studies

3.1 Germany

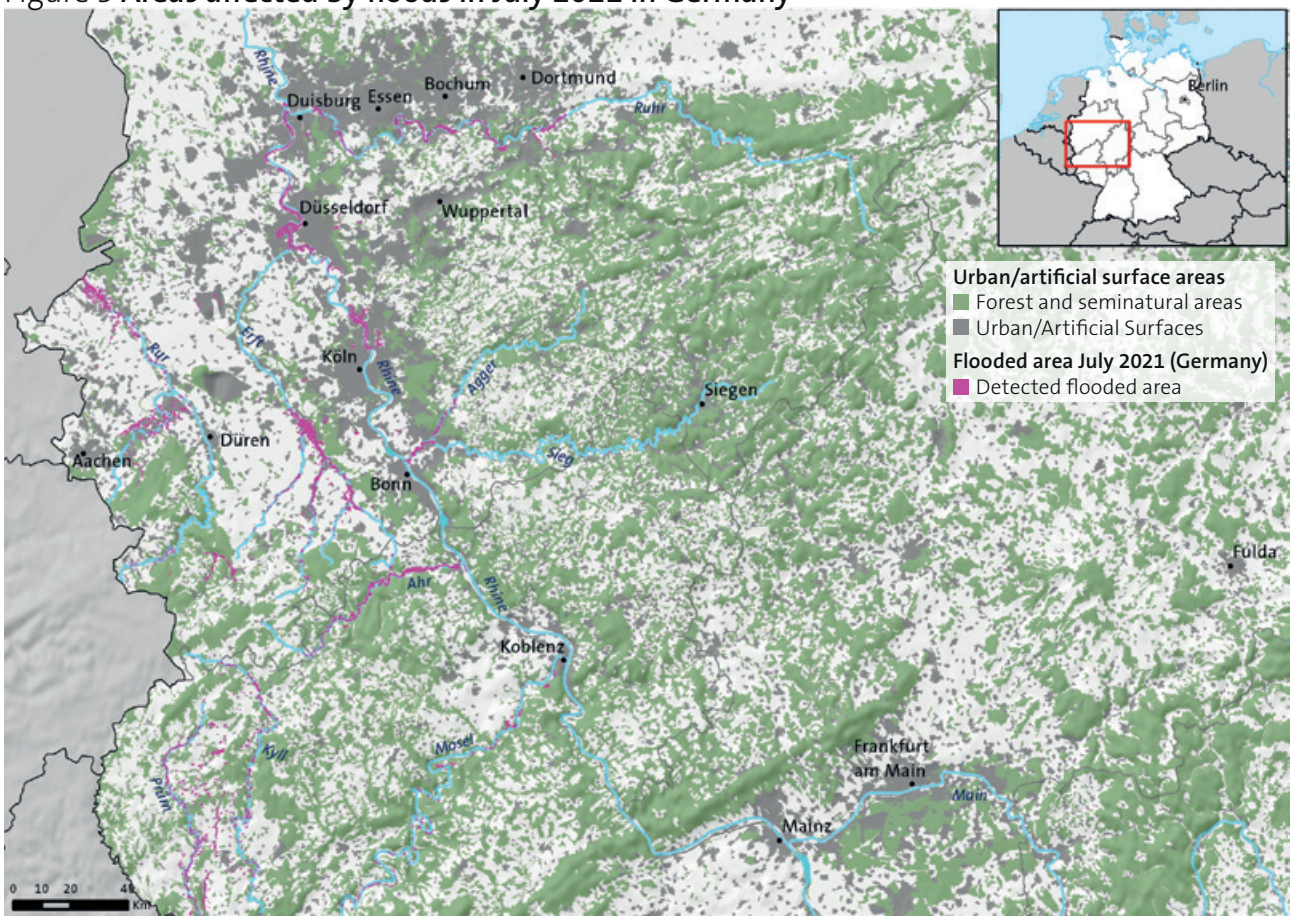
In July 2021, Germany experienced its deadliest floods in 60 years when parts of Rhineland-Palatinate and North Rhine-Westphalia received nearly double the average monthly rainfall in a matter of hours (see Figure 3). The floods wrought havoc, particularly in the Ahr Valley.[93] These regions are no strangers to flooding, as the combination of narrow river valleys and anthropogenic influences, such as surface sealing, intensive agriculture, urban growth, and critical infrastructures have exacerbated the flood-risk. The Ahr Valley and other parts of Rhineland-Palatinate, for example, were also affected by a "hundred-year flood" in 2016.[94] Nonetheless, the speed and extent of the floods in the summer of 2021 took the emergency services and responsible authorities by surprise. More than 100,000 people were affected, at least 190 people died, and hundreds were injured.[95] The floods damaged 9,000 buildings in the Ahr Valley alone, including critical infrastructures and public services, with a total damage estimated of EUR 35–40 billion.[96] A key contributing factors to this disaster was an incomplete chain of alerts, which provided inadequate warnings to both authorities and the public before disaster struck, and resulted in a delayed and hampered response due to a lack of communication and coordination within and between the different levels of government, first responders, and spontaneous volunteers. The extreme amount of precipitation caused by the atmospheric low, named "Bernd", also affected other European countries. Some of these countries, such as Belgium who eventually recorded 41 fatalities, requested assistance from the UCPM.[97] Germany did not.

One year later, Germany, like many other European countries that summer, faced a number of forest fires, and Germany now requested assistance from the UCPM in the form of aerial firefighting capacities, and used the rapid mapping provided by the Copernicus Emergency Management Service.[98,99] Strong spring storms in 2018 and 2022, combined with drought and exceptionally warm summers from 2018 to 2020 and again in 2022, weakened trees and created ideal conditions to fuel these forest fires.[100] For example, only 21 per cent of trees in German forests still have intact crowns – the lowest level recorded since surveys began in 1984. The rate of tree dieback has also increased significantly since 2018.[101,102] Although the area burned in Germany in 2022 (4,300 hectares) was significantly smaller than in other European countries, such as France, it was still well above the long-term annual average (1991–2020) of 646 hectares.[103] According to estimates, the fires caused forestry damage of EUR 30–40 million and more than EUR 600 million in total damages.[104]

The trend towards more heatwaves, drought, forest fires, storms, heavy precipitation, and river floods in Germany due to climate change is not a surprise to civil protection authorities. As part of the German Strategy for Adaptation to Climate Change 2008 (see Section 2.2), the BBK is involved in a number of national fora and networks, such as the Interministerial Working Group on Adaptation to Climate Change, the Strategic Alliance of Authorities "Adaptation to Climate Change",[105] and the Working Group "Climate Change and Adaptation in Civil Protection".[106] The Strategy deemed the German civil protection system to be generally well prepared to respond to extreme events and large-scale emergencies. However, it also stated that more frequent and severe climate-exacerbated hazards would challenge its resources, crisis management structures, and operational planning.[107] Since the inception of the Strategy, the BBK has identified four adaptation possibilities for civil protection – all of which will have positive effects for the overall system regardless of how large or small the climatic changes and associated impacts will actually be in the future.[108] First, it aims to strengthen public preparedness, for example, by increasing risk awareness and self-help capacities through targeted risk communication. Second, it aims to sustain volunteerism. Third, it aims to strengthen critical infrastructures with the help of risk analyses and preventive measures. Fourth, it aims to strengthen civil protection organizations, for example, by ensuring operational readiness and more effective risk- and crisis-communication. Germany is also actively participating in the UCP Knowledge Network, in which, among other things, experiences and lessons learnt from disaster response and relief operations are regularly shared and discussed.[109]

All of these strategies for adaptation are not only desirable, they are also urgently needed. Germany has therefore decided to accelerate and extend the reform of its civil protection system, which were initiated as a consequence of the COVID-19 pandemic. In July 2022, the Federal Ministry of the Interior and Community presented the program "New Start in Civil Protection", which is designed to strengthen the country's crisis readiness.[110] The underlying rationale is to make civil protection a joint national task by optimizing cooperation between the federal government and the States and municipalities through improved integration of all of the actors involved in civil protection. Insufficient coordination and cooperation was a major contributing factor to the suboptimal response to the 2021 floods. This includes coordination and cooperation between response units from various States. In view of the increasingly national scale and higher intensity of climate-excacerbated hazards, it is no longer feasible to solely rely on the States and municipalities for civil protection.[111] While lower levels of government should not relinquish any of their competencies, the federal government should increasingly be involved in order

Figure 3 **Areas affected by floods in July 2021 in Germany**



Source: Copernicus EMSR517

to improve horizontal, vertical, and interdepartmental coordination. The coalition agreement of the current government therefore enables the federal government to assume more responsibility for civil protection matters, and for the realignment of the BBK as a central office with more personnel and material resources.[112]

An important step in this development was the establishment of the Joint Competence Center for Civil Protection (GeKoB) by the federal and state governments in June 2022.[113] The center is located within the BBK in Bonn, with the federal office serving as both host and subject-matter partner. The initial ten employees from both the federal and state governments are supported by an eleven-person BBK secretariat. As a cooperation platform, the center is intended to help strengthen the collaboration of all partners in civil protection. In particular, it aims to increase the exchange of information, to jointly assess risks, to build forecasting capabilities, and to support crisis units at the federal and state level.[114] After the pilot phase, all key actors in civil protection will be represented within the center together with the interior ministries and administrations of the States and the federal government, the THW, the military, and the BBK. Depending on the circumstances, other specialized authorities may be called upon, including aid organizations and partners from the municipal level.

A current project of the GeKoB is the Joint Situation Report on Civil Protection *(Gemeinsames Lagebild Bevölkerungsschutz),* which is managed by the secretariat and informed by information from federal ministries and the States.[115] This new situation report supplements other situation reports on the federal and state levels. In a crisis situation, the GeKoB has the competence to prepare daily situation reports so that, for example, in the event of imminent flooding, weather data can be jointly analyzed, and appropriate warnings issued to the crisis units of the interior ministries of the States.[116] The long-term goal is a shared digital situation report, which includes situational forecasts and assessments of required resources.

Improved cooperation between all levels of government also requires a shared understanding through joint education and training. To this end, the BBK's Academy for Crisis Management, Emergency Planning and *Zivilschutz* (AKNZ) is being upgraded to a cross-departmental and cross-organizational Federal Academy for Civil Protection and Civil Defense (BABZ).[117] In the future, key personnel in state crisis management at federal,

state, and municipal levels will have to complete the same basic and advanced trainings at the AKNZ to acquire cross-organizational qualifications and competencies that complement the specialized training provided by their respective organizations. These training courses will also be mandatory for federal civil protection personal in leadership positions, to which end a second AKNZ site will be established.[118]

The BBK and THW received new positions and additional funding to further strengthen central actors in civil protection. In the 2022 fiscal year, the BBK's funding was increased by 13.5 per cent compared to the previous year, and 112 new positions were created.[119] Substantial investments have also been promised through the "New Start Civil Protection" program to strengthen the disaster protection of the States and municipalities.[120] For example, additional (off-road) vehicles and NBC capacities will be procured to boost the federal government's legally required provision of supplementary equipment to the disaster response units of the States.[121]

The forest fires in 2022 reignited discussion in Germany about the possible acquisition of firefighting aircraft at the federal level.[122] To date, Germany has not had any publicly owned firefighting aircraft. Instead, helicopters from the Military or the Federal Police are used for aerial firefighting when necessary. The majority of experts and politicians have so far rejected the procurement of such aircraft, arguing that their use is only suitable in a few German regions, that there is insufficient demand for them, and that aircraft are available via the UCPM when needed. The increasing risk of forest fires in Germany due to climate change may provide impetus to the counter arguments of the pro-procurement group.[123]

The "New Start Civil Protection" program also gives top priority to the establishment, and further expansion, of a civil defense reserve for the accommodation of evacuees and/or refugees. Since 2020, the BBK has coordinated the pilot project "Laboratory Care 5000" *(Labor Betreuung 5000)* together with the German Red Cross and other German aid organizations.[124] The goal of this project is to equip the federal government's Mobile Care Reserve for *Zivilschutz* with several modules that can accommodate 5000 people each. Each module functions as a mobile, largely self-sufficient accommodation facility for people affected by a short-term emergency, including the provision of heat, water, and food. The first two modules are expected to be operational by 2024.

The devastating floods also showed that the resilience and adaptive capacity of communities need to be strengthened, and the German government adopted a resilience strategy in July 2022 aimed at better preparing and protecting people and their livelihoods.[125] The strategy defines three strategic goals for 2030: 1) integrating existing structures and systems through new or improved measures; 2) closer cooperation between governmental and nongovernmental actors; 3) increasing the dissemination and linkage of information and lessons learnt.[126] To achieve these goals, the strategy aims to increase public understanding of disaster risks, improve disaster risk management through investment in disaster risk reduction and resilience measures, such as public preparedness, building back better, and by nurturing international cooperation. The Inter-Ministerial Working Group for the Implementation of the Sendai Framework for Disaster Risk Reduction steers and coordinates the implementation of the strategy at the federal level together with the National Focal Point for the Sendai Framework of the BBK. A future National Platform for the resilience strategy, with the participation of the States, representatives of local authorities, and members of civil society, science, business, and the media, will help to consolidate the implementation and further development of the strategy in the long term.

To strengthen the resilience of critical infrastructures, the BBK intends to expand its commitment beyond the national resilience strategy.[127] This includes the development of guidelines for risk and crisis management, emergency plans for operators of critical infrastructures, and their dissemination nationwide. The establishment of a strategic emergency power reserve is planned, alongside the development of a more effective emergency power supply concept for companies, authorities, and the public. The emergency supply of drinking water will also be reviewed to make it more resilient. In addition to the refurbishment of the emergency system for drinking water wells, the overall drinking water supply strategy will be adapted to consider climate-exacerbated hazards, such as supply shortages caused by prolonged drought.[128] Awareness-raising efforts will also be intensified to increase public resilience and the capacity of individuals to cope with this hazard.

Germany is currently drafting an umbrella law for critical infrastructures, which intends to supplement the existing legal basis for facilities and services in the area of cybersecurity, with uniform cross-sector and cross-hazard regulation.[129] The new law will comprehensively identify all critical infrastructures, prescribe uniform and cross-sectoral minimum standards for resilience measures, and introduce a new reporting system for security incidents and stately controls in the area of physical security.[130] The goal is to strengthen the resilience of critical infrastructures as an integrated system. According to the proposed bill, the BBK will be given federal responsibility for the physical protection of critical infrastructures.

The public can contribute to the successful management of crisis situations through appropriate precautions, risk-informed behavior, and spontaneous assistance. For this reason, the BBK intends to expand its service provider role vis-à-vis the population as part of the

"New Start Civil Protection" program.[131] A new public service telephone and hotline aims to assist people to prepare mentally and practically, and to provide advice that can facilitate risk-informed decision-making. The BBK also intends to work with aid organizations to establish a program for the recruitment, training, and integration of more spontaneous community volunteers, with the aim to ease the burden for first responders in a crisis. Since spontaneous assistance is predominantly local or regional in nature, solutions are needed not only at the federal level, but also at the state and local levels, to optimize the planning and integration of spontaneous volunteers during a crisis.[132] Organized volunteerism *(Ehrenamt)* as a central element of the German civil protection system will also be strengthened. The BBK is working with relief organizations, the firefighters' association, and the technical relief organization to find new ways and concepts to promote and develop volunteerism further.[133] The BBK intends to simplify access to volunteer positions within the civil protection system by setting up a web-based platform with regional offers and points of contact.

The 2021 floods revealed numerous gaps in the public warning system, which resulted in contradictory, vague and unspecific, or simply no warnings being issued to various affected areas. People were therefore not alerted and informed in time to react in a safe and risk-informed manner. Improvements to how warnings are designed and disseminated is consequently a part of the coalition agreement of the current government.[134] Specifically, the BBK's NINA warning app will be expanded to enable the federal government to communicate clearly and concisely with the public and across all departments in future crisis.[135] In February 2023, cell broadcast was introduced as an additional warning channel.[136] The past two years, the BBK has also funded a program to support states and municipalities to expand and modernize the siren network. Sirens have been the responsibility of the States and municipalities since the end of the Cold War, and during this time the network has shrunk from 80,000 to 15,000 sirens.[137] In addition to new locations, the program has also involved the modernization of sirens with technical upgrades that connect them to the nationwide Modular Warning System (MoWaS). As a result, sirens can now be triggered both by local authorities and by relevant federal and state authorities.[138] Since 2020, all warning channels are tested and weak point are identified during an annual national warning day, which also aims to familiarize the public with the public warning system.[139]

As Germany implements these numerous adaptations to its civil protection system, international cooperation also plays an increasingly important role. Germany has always been a strong proponent of European solidarity in civil protection, for example, by supporting the UCPM with resources and response capacities. However, until recently, Germany relied on its own civil protection system during disasters. The increasing frequency, intensity, and scale of climate-exacerbated hazards have resulted in a greater willingness to request and accept international assistance at both the national and state levels.[140] In 2022, Germany activated the UCPM for the first time to address gaps in its response capacity to forest fires. The German resilience strategy 2022 includes the promotion and expansion of multilateral cooperation for disaster risk reduction, knowledge exchange, and emergency management via the various conferences and platforms of the UN (for example, the Sendai Framework for Disaster Risk Reduction and the InsuResilience Global Partnership), the EU (UCPM), and NATO (Civil Emergency Planning Committee).[141] As an expression of European solidarity, the current government also intends to contribute more German capabilities to the UCPM.[142] Bilateral cooperation in civil protection remains important for Germany as well, not only for knowledge exchange and support during an emergency, but also for strengthening partner countries, such as Tunisia, within the framework of international cooperation projects.[143]

3.2 Austria

When anticipating and dealing with natural hazards, Austria has had a strong focus on floods due to a track record of severe flooding in 2002 (Danube and the Elbe), 2005 (Western Alps), and 2013 (Danube and the Elbe). These disaster management efforts are also reflected in government provisions that focus on flood risk management, such as building regulations and spatial planning, and investments in structural flood-related activities, with an increasing amount allocated to vulnerability reduction.[144,145] However, as reported by the Austrian Panel on Climate Change (APCC) in 2014, and as increasingly experienced in recent years, climate change is prolonging droughts, increasing the frequency of days with extreme heat, and shifting precipitation patterns in Austria.[146,147] As almost 75 per cent of Austrian territory is alpine, it is also vulnerable to global warming patterns that increase temperatures in mountain regions faster than in lowlands.[148,149,150] These changes create favorable conditions for forest fires and, as almost half of Austria is forested, the risk of forest fire urgently needs to be addressed.[151,152]

The number of smaller forest fires in Austria fluctuate between 100 to 300 incidences per annum. In October 2021, however, efforts to suppress a forest fire in the Reichnau an der Rax region of Lower Austria *(Niederösterreich)* quickly got out of control due to the unusually dry and steep alpine terrain, which made it difficult to deploy firefighters on the ground, and few helicopters with high-capacity water tanks were available.[153,154,155] The intensity and scale of the fire also caused coordina-

tion difficulties between emergency services who were collaborating with other municipalities and organizations. When the fire threatened an area critical to Vienna's water supply, Austria requested assistance from the UCPM.[156,157] This was provided through the Copernicus Emergency Management Service and Slovakia, Germany, and Italy responded to the call with firefighting helicopters and planes the next day.[158,159,160] Specially trained Austrian wildland firefighters also played a central role in controlling the spread of the Rax fire. This small group had acquired practical forest fire experience through training in Portugal and Spain, as well as during UCPM deployments. An interviewed expert described them as "knowledge multipliers" in a civil protection system unprepared for climate-exacerbated forest fires.[161]

In March 2022, Lower Austria once more faced a major forest fire, which burnt a significantly larger area than the Rax fire (1,200 compared with 109 hectares).[162,163] These forest fires are not just a concern due to the damage caused by the high intensity fire, but also because of their cascading effect. Forests can act as a natural safeguard against avalanches, landslides, and soil erosion in mountainous terrain, which in turn protects the flow of waterways and reservoirs from debris and associated flooding.[164,165,166,167] Each step of such a cascading set of events have the potential to strain Austria's civil protection system short- or long-term.

The federal government first initiated a national action plan to address the impact of climate change with the adoption of the *Austrian Strategy for Adaptation to Climate Change* in 2012. The Strategy consists of recommendations in 14 action domains, with the aim to reduce public vulnerability to climate change by strengthening adaptive capacity.[168] The action plan is subject to recurring progress reports (completed in 2015 and 2021), and allows for adjustments to the Strategy based on new scientific or methodological findings (such as in 2017). Within the Strategy, the domains of "Protection against Natural Hazards" and "Disaster Management Sector" are central to civil protection. A notable progress achieved between 2017 (adjusted strategy) and 2021 (second progress report) is the operationalization of a national platform for the Austrian Strategy for Disaster Risk Reduction (ASDR), which aims to implement the Sendai Framework for Disaster Risk Reduction in Austria.[169] The ASDR platform can be seen as a nationwide structure for cooperation between federal and state ministries, mission organizers, scientists, and the private sector to exchange experiences and concepts, coordinate strategies, create synergies between the task implementation of different institutions and organizations, and for joint developments in crisis prevention and intervention.[170,171]

Action points in other domains of the Strategy also support civil protection by offering recommendations that tackle hazards and their associated risks. For example, Action Domain Forestry calls for the establishment of preventative measures to address the growing risk of forest fires.[172] By 2021, a publicly accessible warning system for forest fires had been created, and forest fires incidences were documented in a database.[173] Further support for managing forest fires is provided by a network of forest roads that are observed and surveyed, better GIS-maps, access to water ponds that are used for snow canons in winter, and some fire departments have been equipped with specialist equipment. However, from a resilience point of view, there is still a lack of public awareness of the danger of forest fires.[174] Plans are under way for the creation of up-to-date advice for forest owners on maintaining healthy forests. Each of these steps have the potential to contribute to the prevention and recovery phases of disaster risk management.[175]

All of these action points are supported by a new national forest fire action program, *Brennpunkt Wald: Aktionsprogramm Waldbrand,* which was adopted in 2020.[176] The action program is backed by a specifically created sub-fund of the Forest Fund Act *(Waldfondsgesetz),* with over EUR 11 million dedicated to forest fire prevention.[177,178] The action program was originally scheduled for release in August 2021 (prior to the Rax fire), but a delay caused by various administrative processes enabled an extension of the underpinning expert survey, which could then be cross-checked with the actual events during the Rax fire, resulting in the release of a more robust action program in August 2022.[179]

The action program aims to enable adaptation to climate-exacerbated forest fires in Austria by improving the national risk assessment, and by encouraging knowledge sharing between municipalities within the nine federal states and provinces and with international experts. It consists of 39 measures, which are the aggregated input provided by 17 institutions, and with a time horizon until 2030. Target domain II, *Gemeinsam Waldbrand vorbeugen und bekämpfen,* intersects with civil protection by promoting networking and collaboration between stakeholders, emphasizes preventive actions in high-risk areas, and a call for targeted measures in managing forest fires.[180] The *Sonderdienste* (special services) of the Lower Austrian firefighters association provide an example of such a targeted measure. The *Sonderdienste* of Lower Austria are dispatches of firefighters with additional training for specific tasks (e.g., diving or medics). They are allocated to one of four geographically-divided duty stations within the province of Lower Austria. These *Sonderdienste* bring their enhanced knowledge to emergencies, and can advise operational control as subject matter experts. In January 2020, the association had already decided to create a new branch within these *Sonderdienste* with a focus on forest fires. The plan is for each of the duty stations (South, West, North, and East) to have circa 50 volunteer firefighters with additional training in forest

fires and a logistics component dedicated to forest fires. Another example is the planned improved communication with private forest owners that currently are disengaged or lacking guidance, to ensure that prevention and mitigation solutions are locally supported.[181]

The Rax fire ignited a discussion amongst experts and authorities about Austria's capacity to cope with climate-exacerbated forest fires.[182] One argument brought forward by a member of parliament concerned the critical state of the military's Black Hawk helicopter fleet. The only two helicopters that were operational were deployed to the Rax fire, but if more had been deployable, external support would arguably not have been necessary. This argument aligns with the government's assessment of the Rax fire, which found that the UPCM's resource support was not needed, as there were too many responders on the scene. It should be acknowledged that it was the first time Austria collaborated with the UPCM on homeground, and there may therefore have been some teething problems. However, it was clear that Austria benefited from the collective expertise and know-how made available through the UCPM during the Rax fire. The ministries therefore want to facilitate an exchange of experts and knowledge both between the different levels of government in Austria and with international partners. To date this has only been standard practice within the ministries and with academia. They assess that Austria, in general, has enough firefighting capacities for incidents like the Rax fire, but that more trained wildland firefighters and specialized vehicles are needed going forward.[183]

By accounting for civil protection capabilities in tandem with the national climate change adaptation strategy, and by strategically drawing on existing laws and provisions, such as the Forest Fund Act, Austria has created opportunities to adapt civil protection to the known and predicted hazards associated with climate change. For example, areas considered vulnerable to forest fires receive funding from the national Forest Fund Act for specialized equipment to district level firefighting units.[184] *Aktionsprogramm Waldbrand* pushes for overarching alliances to enable collaboration between actors that ensures synergies and information exchange. Moreover, the federal government tries to overcome the obstacles of federalism in crisis management by offering support to the provinces to implement the adaptation and action programs.[185]

Recent forest fires have also provided political momentum to enhance prevention and response capacities to natural hazards more broadly.[186] In October 2021, the government presented a new law on crisis security *(Bundes-Krisensicherheitsgesetz)* that was open to public feedback in the first quarter of 2023.[187] The law aims to facilitate rapid coordination (i.e., structures and processes) among authorities and institutions in crisis situations, regular everyday exchange of information, the creation of a new situation center within the Ministry of Interior, the establishment of a legal definition of what constitutes a crisis, the appointment of a government advisor for crisis affairs, and an expansion of the military's range of responsibilities in crisis situations.[188,189]

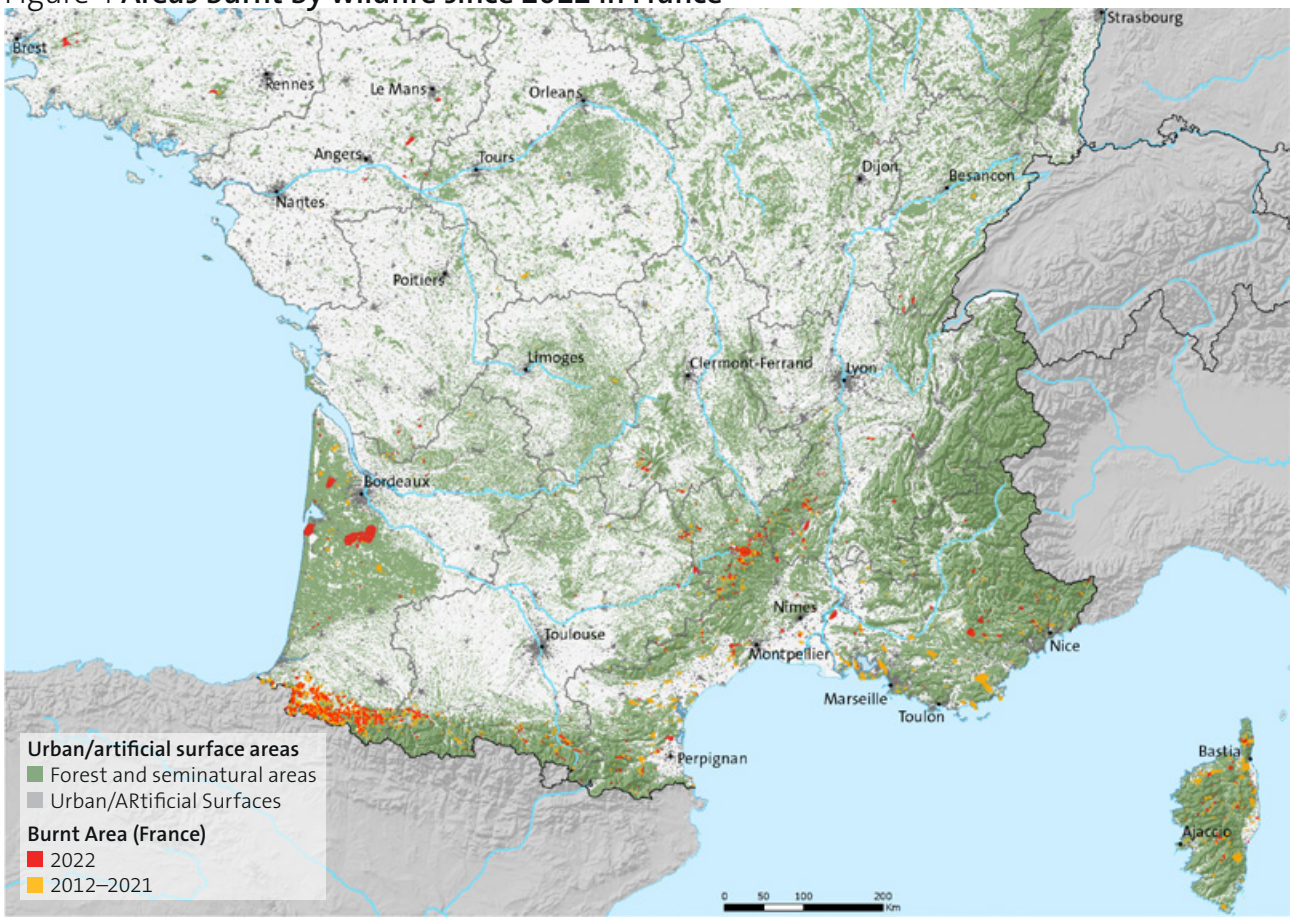
3.3 France

France was one of many European countries who experienced severe drought conditions in 2022.[190] Research found the record conditions were twenty times more likely to happen due to climate change.[191] 2022 was the hottest year recorded in France since data collection began in 1900.[192,193] The summer was the hottest and deadliest since the record heatwave in 2003, with more than ten thousand additional deaths.[194] By early August, more than one hundred municipalities in France had run out of drinking water, and water use was restricted in nearly all metropolitan departments.[195] Together with successive heatwaves, these conditions created extreme fire danger, and during July and August 2022 forest fires burned the biggest annual area (72,000 hectares) in France since the change towards fire suppression policies in the south of France in the 1990s (see Figure 4).[196,197,198] The catastrophic fires were also unusual in that they burned in multiple regions simultaneously, and in regions that traditionally are not considered fire-prone, such as Brittany and the highlands of Jura and Vosges.

The triple-impact of drought, water scarcity, and forest fires triggered calls for national reforms. The reforms required are urgent. According to the French Minister of Ecological Transition and Territorial Cohesion, global warming is causing a 15–40 per cent loss of water availability for France.[199] The release of a national plan for water management is long-awaited. The cascading effect of drought, and the possible consequences for critical infrastructure, is predicted to be one of the biggest climate-exacerbated challenges going forward (alongside heatwaves, floods, and forest fires). There is consequently a need for better detection, monitoring, and forecasting of drought conditions across France.[200,201] By the end of February 2023, the rainfall deficit had increased for 15 months, and with 80–85 per cent less rainfall that month than on average, the French government issued a water-warning with potential tougher measures to follow. While the conditions had improved somewhat by late April, the continuing drought means groundwater replenishment is well below average.[202] The summer of 2023 may therefore become even more challenging than that of 2022 in terms of drought, water scarcity, and forest fires.[203]

The cascading effects of climate change pose a significant challenge for policymakers and emergency managers, particularly when it results in an unexpected

Figure 4 **Areas burnt by wildfire since 2012 in France**



Source: JRC EFFIS

or hitherto unknown increase in the intensity, frequency, and scale of natural hazards.[204,205,206] Understanding why the current conditions are so challenging for forest fire management in France – a country who is no stranger to forest fires, is therefore clearer when viewed in a historical context. Historically, only the south of France was considered fire-prone, with a distinct fire season. All policies and resources were therefore organized to prevent and fight forest fires in the south, along the Mediterranean Sea and in the Pyrenees more so than in the regions towards the Atlantic Ocean. Many of the forests in the south are not natural, but planted and intensively managed, and land managers, foresters, and firefighters were confident in their firefighting abilities because the forests were well managed. However, according to an expert interview, the detrimental impact of climate change, in particular drought, on the health of the trees, together with an increase in fuel load, had been inadequately calculated.[207] Additionally, the growth of the wildland-urban interface (WUI), and the challenge of conveying the importance of forest maintenance to the owners of the private forests, which make up circa 90 per cent of forests across France, pose significant challenges. Forest maintenance is expensive and time-consuming work, and given the proliferation of forest fires across France, this is a problem that needs more proactive information dissemination, with the support of municipalities, particularly in regions that were not considered fire-prone in the past. The replanting of drought- and fire-impacted forests also needs careful consideration.[208,209,210] Healthy forests are important for a range of environmental reasons, in addition to the economic value of forestry, and given the growth-time required for most forests to thrive, it is crucial to consider now what tree species can adapt to or tolerate our climate-altered future.[211] In response to these challenges, EUR 150 million of a EUR 2 billion government-provided "Green Fund" have been earmarked for private and public forest owners for "renewal and adaptation to climate change", starting in 2023.[212,213] An additional EUR 50 million will be allocated to research, including experiments on tree species adaptation to climate change.

An expert interview also highlighted the need for more outreach and community engagement across all levels and regions of French society to shift a current disengagement with, or lack of knowledge about, climate change, to an understanding of the everyday impact of

climate-exacerbated hazards.[214] Ninety per cent of forest fires are ignited accidentally by humans in France,[215] and the need to better inform the public about fire behavior, ignition, and prevention was flagged in an expert interview.[216,217] Overall demographic differences between the north and south of France, as well as seasonal influxes of tourists, make it challenging to find an all-round efficient communication method and message. Risk management can be difficult to explain to a group of experts, let alone a culturally and demographically diverse population. The south of France, for example, has a higher proportion of retired residents than many other regions of France. While many residents have an appreciation of hazards due to personal experiences, the region is also inundated by tourists during the summer (fire season), many of whom are in a no-news-following "holiday mode" or have little knowledge of local conditions and risks.[218] The same applies to flood hazards in different regions during spring. There is also an identified need to improve who communicates about what, to which people, when, and why. Messages should ideally be coordinated across municipalities and services, with clearer guidance to people on how to act in an emergency. Multidimensional local approaches are generally known from disaster research to be more effective for engaging people.[219,220,221,222] Yet, in a centrally structured civil protection system, it can be challenging to obtain support for bottom-up initiatives or the resources needed to address diverse local needs. A new measure by the Government – the "forest weather report" – will go some way to address this gap, by providing each department with a two-day risk forecast on a four-level-scale, with prevention messages accompanying the highest levels of risk.[223]

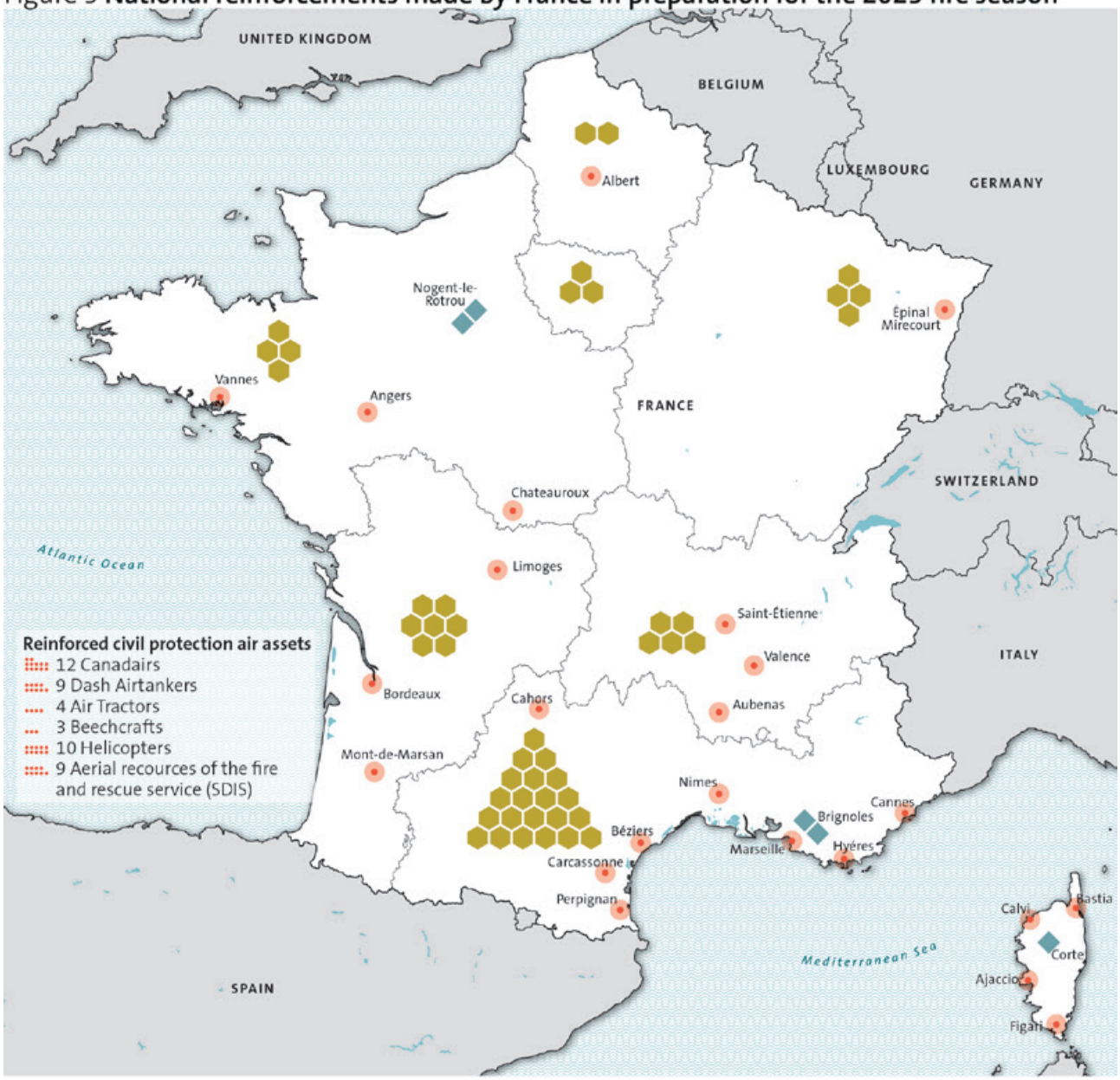
The scale, frequency, and severity of the 2022 forest fires also highlighted the stress on, and need for more, trained volunteer firefighters, and the importance of international assistance, particularly through the UCPM, in order to cope with concurrent forest fires.[224,225,226] Ongoing monitoring of fire danger ratings before the commencement of the 2022 fire season had already highlighted the need for more trained wildland firefighters across France, and not just in the traditionally fire-prone regions. The reason why this problem had not been addressed was described in an expert interview as the troublesome gap that often exists between the moment when awareness of a problem emerges due to monitoring trends, and the moment when adaptation measures are in place to respond to the changing conditions.[227] Acknowledgment of this awareness-preparedness gap is particularly relevant for Switzerland given the current efforts to prepare and adapt the Swiss Civil Protection system to climate-exacerbated hazards, like drought, water scarcity, and forest fires, before they become acute.

Most firefighters in the north of France are not currently trained in wildland firefighting. While such training had been planned for a while, it had not been implemented due to time and fiscal constraints as well as competing priorities. An expert interviewed estimated that many more trained firefighters are needed – both to respond to more forest fires and because longer fire-seasons are placing a strain on firefighters who need holidays to rest and recuperate.[228] The historical mobilization of circa 1,000 firefighters from the north to the south of France during the fire-season is no longer possible, as the resources are now required in the north too. Furthermore, France, like other fire-prone regions of the world, are struggling to recruit and retain volunteers firefighters, particularly in rural areas, due to demographic and lifestyle changes as well as the demanding conditions placed on volunteers.[229] There have therefore been calls to make it easier for employers to release volunteer firefighters, initiatives to facilitate the training and secondment of volunteer firefighters, and proposals for fiscal and insurance benefits that will encourage both employers and employees to support volunteering. There is also an urgent need to take seriously the mental health of firefighters and emergency managers,[230,231] while simultaneously addressing the angst of residents at-risk.[232,233] The capacity to cope both with the potential and the reality of climate-exacerbated hazards is greatly increased with mental and practical preparedness.[234,235,236]

The summer of 2022 provided the momentum needed for French authorities to commit to strengthening firefighting capacities. In April 2023, an upscaled response strategy was announced for dealing with multiple forest fires burning simultaneous in multiple regions.[237,238] In order to uphold the target response time during high-risk periods (i.e., within 10 minutes of a fire's detection),[239] the number of zonal reinforcement brigades *(colonnes)* will be increased to 51 in 2023 (compared to 44 at the height of the 2022 fire season) (see Figure 5). Each brigade consists of a command and support vehicle and three forest fire intervention groups with 70 firefighters. Additional reinforcement will also be made available through the Hephaestus protocol, which links the Ministry of the Armed Forces with the Ministry of the Interior and Overseas. In addition to the existing 650 personnel from the military civil security formations, a reinforcement of up to 150 soldiers in three support units and four foot platoons will be mobilized in 2023 for the creation of track and firebreaks.

In addition to more boots on the ground, the Ministry of the Interior and Overseas' current five-year plan seeks to improve firefighting capacity through a strengthened role for prefects during large-scale crises; improved daily assessment and communication of hazards via the new "forest weather report" that expand detection, monitoring, and forecasting capacities via a collaboration between Météo-France, the National Forestry Office, the Fire and Rescue Services, and the Regional Association for the Defence of the Forest Against Fires;[240] an updated aerial

Figure 5 **National reinforcements made by France in preparation for the 2023 fire season**



3,300 firefighters specialized in fighting forest fires, in 46 brigades *(colonnes)*. (● = 1 brigade)
360 civil protection personnel in 5 columns. + 11% more dedicated civil protection personnel than in 2022. (◆ = 1 brigade)
Reception facilities for civil protection airborne resources.

Source: Adapted from the French Ministry of the Interior and Overseas, 2023

firefighting fleet; and the joint financing of equipment shared between fire and rescue services.[241] There is also an awareness of the need to improve the flexibility of resource mobilization, for example, by prepositioning resources at the closest likely ignition points, and by making more equipment and airports ready across France (see Figure 5). The resources outlined in Figure 5 include two new Dash Airtankers, three new water bomber helicopters, and four new Air Tractors that will be purchased or leased to boost the existing aerial firefighting fleet before the height of the 2023 fire season. In the coming years, the Canadair fleet will be completely renewed and four additional aircrafts will be purchased. From 1 June 2023, all of these aerial resources will be managed at the national level with oversight provided via the Operational Center for Interministerial Crisis Management on the Nîmes-Garons Civil Security base in the south of France.

Equipping all of France for a drier and more fiery future is a costly endeavor with a carefully mapped out budget. It also draws on bilateral agreements and international cooperation to enhance adaption. For example, the scale of the 2022 forest fires not only resulted in an

appeal to employers to release volunteer firefighters to assist exhausted crews, it also led to requests for international assistance, which was provided through the UCPM. France was not the only country requesting assistance to manage forest fires that summer. The increasing need for international assistance in multiple countries simultaneously, due to overstretched national capacities, is posing a challenge for the UCPM. The 2022 fire season in Europe therefore triggered an extraordinary EU ministerial meeting on forest fires in January 2023, where the decision to double the UCPM's firefighting capacities before the 2023 fire season was confirmed.[242,243] This was followed in February 2023 by the adoption of a set of disaster resilience goals by the European Commission that aim to:[244,245]

1. Anticipate by improving risk assessment, risk anticipation, and disaster risk management planning.
2. Prepare by increasing risk awareness and preparedness of the population.
3. Alert by enhancing early warning.
4. Respond by enhancing the UCPM response capacity.
5. Secure by ensuring a robust civil protection system.

Point 4 of the disaster resilience goals single out two specific climate-related hazards in need of enhanced response capacity – forest fires and floods, with particular attention given to the minimum and maximum days of response availability, and the minimum number of Member and Participating States that can be helped at any given time:

> Article 4.1: "The Union Mechanism should at least be able to respond to needs in six Member States simultaneously with aerial forest fire fighting capacities once national capacities are overwhelmed, for a minimum of 1 day and a maximum of 7 days. In parallel, the Union Mechanism should at least be able to respond simultaneously to needs in four Member States with overwhelmed national response capacities with ground wildfire fighting capacities, for a minimum of 7 days and a maximum of 14 days. Additionally, the Union Mechanism should be able to deploy firefighting advisory and assessment teams for tactical advice to two simultaneous requests for assistance due to wildfires."
>
> Article 4.2: "The Union Mechanism should at least be able to respond to a flooding event affecting at least three Member States simultaneously with overwhelmed national response capacities. Such response should cover at least the total capability to pump at least 20,000 m^3 water/hour, for up to 21 days. In addition, the Union Mechanism should be capable of ensuring flood containment, waste management, dam assessment, and search and rescue operations in a flooding situation."

France is a big supporter of international cooperation, with French civil protection experts providing on average 500–600 actions of cooperation per year.[246] The Network of European Multi-hazard capacities hub of Scientifics Understanding and Sharing – better known as NEMAUSUS, provides an example of how France is linking national and international initiatives. NEMAUSUS was initiated in 2021 with the long-term objective to transform the existing civil security base in Nîmes-Garons into a fully-fledged European center of expertise dedicated to forest fires.[247,248] The pilot phase aims to implement capacity building and scientific activities, in line with the pillars of the Union Civil Protection (UCP) Knowledge Network, and is open to UCPM Member and Participating States, as well as interested European Neighbourhood Policy countries.[249]

On a bilateral basis, France has cross-border agreements for daily business matters, including mutual assistance in the event of a major incident via close cross-border cooperation. The competing demands on UCPM and rescEU resources, and the consequent inability of the UCPM to respond to all requests during recent summers, has highlighted the equal importance of bilateral agreements for assistance during emergencies and disasters. For example, in response to worsening fire seasons, Greece and Portugal signed a bilateral agreement in early 2023 for mutual assistance during catastrophic forest fires.[250] This raises a question about changing coordination needs with changing seasonal needs across different territories in Europe, and the potential need for regionalized UCPM coordination to meet the disaster resilience goals. One expert highlighted the difficulty of raising this point in an EU-context due to the solidarity clause that underpins all of DG ECHO's work.[251] However, they stressed that the UCPM will have to position itself and manage this situation, as EU-funded resources will likely be deployed in these new forms of bilateral / cross-regional agreements.

One area where the UCPM is proactively expanding its reach is through its collaboration with the Union for the Mediterranean (UfM), to implement its southern civil protection pillar, and to explore the possibility for a regional solidarity mechanism. The UfM is exploring ways for its southern region to support its northern region due to the long-lived experiences of climate-exacerbated hazards, such as drought and water scarcity, in countries, such as Morocco. At the moment, the UCPM provides assistance when it is requested by countries to the south of the Mediterranean, but not vice versa. The UfM is therefore seeking to expand the mechanism of solidarity to these countries, which are in close geographical proximity and have hard-won climate change experience to share.

The challenges posed by climate-exacerbated hazards in mountainous terrain also makes regionalization of resource deployment a relevant topic for Switzer-

land and the Alps. Mountains have the capacity to "trap" problems (access, heat, floodwater, debris flow, etc.) in valleys and lowlands, and the ability to be adequately prepared therefore requires skillful anticipation and resource allocation through information and capacity sharing with neighboring countries. Multiplying bilateral agreements with all neighboring countries is particularly important for Switzerland, as long as it is not a Participating State of the UCPM.[252]

3.4 Italy

Italy is vulnerable to the effects of climate change due to its diverse climatic conditions.[253] As a part of the Mediterranean region, it is a hotspot for highly interconnected climate risks.[254] During 2022,[255] northern Italy experienced severe drought conditions, particularly along the Po River basin, which provides roughly half of Italy's water resources.[256] The drought conditions deteriorated during the summer, which was characterized by high temperatures and evapotranspiration rates, and a significant precipitation deficit (with negative cumulative average spreads that exceeded 50 per cent of the long-term averages). The consequent severe water deficit continues to have significant socioeconomic impacts, such as reduced crop yields, failed harvests, reduced availability of hydroelectric power, and compromised cooling systems across northern Italy's power plants.[257,258,259,260] Ecologically, the hot and dry conditions in the Alps have increased the presence of pests, such as the European spruce bark beetle *(Ips typographus),* which poses a threat to the health of forests that act as a natural protector from avalanches. In aquatic ecosystems, the warmer, slower flowing, and less abundant waters have resulted in a rise in filamentous algae, common bacteria, and pathogens.[261]

Between 6–15 per cent of the Italian population is now estimated to live in regions experiencing severe or extreme drought.[262] While some regions of southern Italy have adapted their regional monitoring systems to better manage drought due to a longer history of periodic water scarcity, northern Italy is less accustomed to persistent dry weather conditions. Until recently, it could rely on the accumulation of snow in the Alps during winter, which would replenish the flow of water through river basins with the spring thaw. However, the winter precipitation levels in 2022 failed to alleviate the drought, with a significant snow deficit in the Alps (minus 69 per cent) compared to a 12 year-average.[263] The temperature anomalies at higher altitudes is also accelerating the thaw of permafrost and glaciers. In July 2022, 11 people were killed when the Marmolada Glacier in north-eastern Italy collapsed after temperatures exceeded 10°C for multiple days.[264,265]

The forest fires season in 2022 was also impacted by the heatwave and drought, with an unusually high number (38) of firefighting interventions in the Italian alpine region compared to the previous year.[266] However, not all of the natural hazards that impacted Italy that year were shaped by drought. Southern and parts of central Italy had intense local meteorological downpours that lead to extensive flooding on the Aeolian archipelago in August 2022 and in the Marche region in September 2022, and cause landslides on Ischia in November 2022. According to the European Severe Weather Database, Italy experienced more than 3,190 severe weather-related events in 2022, up from 481 events in 2012.[267]

The prolonged and widespread impact of the 2022 drought led the Council of Ministers to declare a national state of emergency in July 2022 across nine regions and autonomous provinces in northern and central Italy.[268] The state of emergency was extended in January 2023 for the remainder of the year, and includes newly affected regions.[269] The declaration enables affected regions to receive immediate financial relief from the fund for national emergencies, which is administered by the Department of Civil Protection. Additionally, as the drought affects not only different administrative divisions (municipalities, regional/provincial, State), but also a wide range of ministries, the Italian government established a steering committee to address the national water crisis and identify intervention priorities. The committee is chaired by the Prime Minister and includes representatives form many ministries, including the Chief of the Department of Civil Protection and the Minister of Civil Protection and Marine Policies. Among the national initiatives proposed, is the allocation of EUR 3.9 billion from the National Recovery and Resilience Plan to address water management issues.[270] According to the ISTAT, the national statistical institute, total losses in water distribution amounted to 3.4 billion cubic meters due to a malfunctioning water network. This is equal to 42 per cent of the water introduced into the network.[271,272,273]

At a local level, several Italian regions and autonomous provinces have taken more immediate steps towards addressing the water shortage, such as restricting water usage in the tourism sector. Yet, the governance of the drought crisis in Italy has been fragmented due to the diverse needs of different regions and economic sectors.[274] It points to the need for a homogeneous national strategy to counter the effect of the re-organization of the National Civil Protection Service (Legislative decree 1/2018), which assigned more powers to regional and provincial entities and consequently 21 slightly different regional/provincial civil protection systems that, while following national guidelines, differ in terms of organization and operations. The shortage of water could result in competing demands for access to water across regional and international borders,[275] although counter examples

also exist, such as the collaboration between the Veneto region and Province of Trento in north-eastern Italy to efficiently manage hydro resources across the Adige river basin.[276] Italy shares water rights with Switzerland for Lake Maggiore and with Slovenia for the Isonzo river.[277] The decision by the Italian authorities to raise the maximum reservoir level of Lake Maggiore by 1.35 meters above the hydrometric zero is contentious, as the consequent increase in water reserves for agricultural activities in the Po valley will pose significant challenges for lakeside settlements in both Italy and Switzerland.[278] This points to the importance of healthy bilateral and multilateral agreements.

Italy's bilateral agreements with neighboring countries have become less influential in preparing for and managing climate-exacerbated hazards since the UCPM was established in 2001. While Italy still participates in bilateral initiatives to strengthen institutional collaboration, multilateral agreements are preferred from an operational perspective, according to an expert interview.[279] Italy has always been a strong supporter of the UCPM, and the integration of the UCPM's systems, processes, and resources into Italy's national civil protection system has resulted in the creation of a universal language and standardized operational procedures that are understood across the Member and Participating States. The expert also expressed a strong belief that Switzerland has the potential to play a significant role in the UCPM.

Cooperation between Italy's civil protection and civil defense systems is another key aspect of how Italy adapts to a changing hazardscape. In contrast to the decentralized civil protection system, the centralized civil defense system specifically deals with safety and security issues that could undermine the national democratic institutions and create socio-political instability. However, the Armed Forces can be called upon to contribute and perform specific duties, such as the provision of technical, operational, and logistical support to national and territorial administrative organizations.[280] This includes cooperating with the civil protection system for tasks, such as search and rescue operations, removal of rubble material, restoration of critical infrastructure, preparation of base camps for rescuers and shelter areas for impacted groups, and the mobilization of military vehicles (ground, air, and naval) to manage the influx of rescue forces or to transport casualties.[281] Examples of successful cooperation, includes the provision of aircraft support for regional firefighting operations during the 2022 fire season,[282] and in the aftermath of the recent earthquakes in Turkey and Syria, the Armed Forces provided medical supplies, instruments, and personnel, and conducted search and rescue activities within the framework of UCPM.[283,284]

The incentive behind the employment of the Armed Forces in non-military operations is twofold. It satisfies a perceived need to utilize resources already financed by the public sector, and it increases the capacity to cope with increasingly complex crises linked to climate change, pandemics, mass migration, energy supply shortages, etc. In an expert interview,[285] recognition of the importance of the Armed Forces for civil protection tasks via the dual use of their skills, technologies, and assets, rested against a clear understanding that their role is ancillary and not a substitute for the civil protection system.[286,287] While the Armed Forces offer additional crisis support, the integration of different bodies and actors into the civil protection system creates challenges in terms of organization and structural coherence. The expert highlighted that future issues may arise concerning the integration of the Armed Forces within the civil protection system, due to the move of civil protection from the Prime Minister's portfolio to the Minister of Civil Protection and Marine Policies. This change has created uncertainties, and it is still unclear how this may affect the various functions and operations of the Italian Department of Civil Protection.

4 Conclusion

Lessons learnt

Recent climate-exacerbated hazards and consequent flooding, drought, and forest fires have led to tangible changes within the civil protection systems of the countries analyzed in this study. In Germany, a wave of reforms is gradually being rolled out across civil protection policy and practice in response to the disastrous 2021 floods; changes already evident in the response to more recent forest fires. In Austria, the lessons learnt from the 2021 forest fires aligned with policy changes already in train, enabling the timely release of a strategic forest fire action program as well as practical changes that enhance Austria's capacity to manage and respond to forest fires. In France, the climate shocks experienced during 2022 made it painfully clear how the scale and frequency of known hazards have increased, resulting in a need for more resources and personnel that are now being procured, trained, and deployed. In Italy, a recent political change is resulting in structural changes, but overall its civil protection system – with its reliance on organized, trained volunteers and a well-integrated collaboration with the police and Armed Forces – has been thoroughly tried and tested over time, and no major changes in response to recent events had therefore been considered necessary at the time of this study.[288]

Our study also emphasized the important role the UCPM plays in enabling timely forecasting and knowledge exchange, and as an invaluable back-up when climate-exacerbated hazards overwhelm national resource allocation and response capacities. All four countries requested and received assistance from the UCPM in response to recent events. In the case of Germany, a hard-won lesson was also learnt when external assistance was not requested, which contributed to the response to the 2021 floods quickly spiraling out of control. Furthermore, our study point to the critical need to continually assess and adapt the UCPM's capacities, outreach, and structural set-up in response to the increasing frequency, scale, and intensity of climate-exacerbated hazards across the European continent.

A key overall finding from our study, which the following subsections respond to, is the troublesome gap, which often exists between the moment when awareness of a problem emerges due to monitoring of trends, and the moment when adaptation measures are in place to respond to the changing conditions (e.g., as evidenced with the catastrophic drought and forest fires in France). Acknowledgment of this gap is particularly relevant for Switzerland in its current strategic quest to adapt its civil protection system and boost societal awareness of climate-exacerbated hazards before the toll of regular heatwaves, drought, water scarcity, flooding, and forest fires also become acute in Switzerland with climate change.

Linking national strategies and action plans

Our study highlights the benefits of holistic rather than sectorial approaches to risks, as activities carried out during different stages of the integrated risk management cycle invariably form part of a greater whole. Austria's forest fire action program provides an example of how the development of a national strategy can clarify responsibilities and streamline the coordination of resources and activities across national, cantonal, and municipal stakeholders in all phases of the integrated risk management cycle: preparedness, mitigation, response, and recovery. The lack of such clarity and coordination across Italy's drought impacted regions provides an example of a hazards management gap that would benefit from the development of a national drought strategy, which is attuned to how climate change exacerbates existing problems and leads to the onset of many others. Germany's integration of drought into its drinking water supply strategy is an example of how consideration and recognition of climate-exacerbated hazards and their potential impacts can be integrated into relevant planning and preparedness documents at all levels of government, such as regional risk analyses, risk maps, and local emergency plans.

The lessons learnt from recent disasters show how civil protection can be used as a guiding principle for broader environmental and infrastructure assessments, capability frameworks, and new policies and legislation that are concerned with climate change adaptation and mitigation.[289] Linking action programs with existing national and international initiatives can also ensure funding and a legal basis that can enhance and streamline program implementation. Direct funding from the Forest Fund Act, for example, propelled the implementation of Austria's forest fire action program. Similar possibilities exist for aligning strategic action with existing Swiss legal frameworks, such as the Federal Act on Forest, which outlines measures for the prevention and remediation of forest damage (chapter 4, section 2), with Article 28a specifically highlighting action against climate change.[290]

Our study also points to the importance of establishing thresholds for preparedness and management activities for slow-onset disasters. While subsidiarity in civil protection works well for acute disasters, it is less attuned to slow-onset disasters due to the difficulty of long-term resource planning and cooperation across federal departments and cantons where shared processes and responsibilities are not always clear.[291] At the federal level, cooperation across international borders is critical for shared resources, such as water catchments and rivers, and investments in bilateral and multilateral agreements

is of outmost importance both before a crisis threshold is reached and during acute disasters. On cantonal and municipal levels where the importance of integrated risk management has been widely recognized, it is critical to regularly review the impact of climate change on respective risk management plans, and for others to support them in doing so by sharing knowledge and contacts. National strategies could prove helpful for the coordination of activities between different levels of government in order to prepare for and respond to the growing risk of climate-exacerbated hazards, such as heatwaves, drought, and forest fires, which Switzerland so far has not been widely exposed to and therefore broadly lacks hands-on experience of.[292]

Deepening vertical and horizontal integration

Given the challenges ahead, Swiss Civil Protection and crisis units across all levels of government would benefit greatly from adapting now so they are ready to tackle the unfolding challenges of climate-exacerbated hazards. This will require mandatory, harmonized, and joint education and training of crisis units on all levels, with the aim to foster sensitization and professionalization of crisis units, particularly on lower governmental levels. More regular cantonal and inter-cantonal hazard management exercises would build capacity and foster knowledge sharing. The FOCP has an important role to play, not just as a service provider for the cantons in the area of natural hazards, but through more active involvement with lower levels of government to foster disaster preparedness, resource coordination between cantons, and by sharing federal resources.[293]

Fostering knowledge sharing

One lesson that runs through all of the reform efforts analyzed in this study is the urgent need to increase and formalize knowledge sharing via first-hand experience, lessons learnt, and best practice across all phases of the risk management cycle. The benefits of such knowledge sharing can be used by both experienced and less experienced stakeholders to optimize their own preparations, and to identify adaptation needs at diverse spatiotemporal scales. Linking experience and expertise across relevant national authorities and ministries, and with international partners, can also assist decision-makers to adapt to increasingly complex risk scenarios and the cascading effects. Accordingly, the consequences of climate-exacerbated hazards should not only be evaluated within the affected organizations, but regularly shared with as wide an audience as possible. This requires increased networking among civil protection actors, including more vertical and horizontal sharing domestically, ongoing exchange with civil protection systems beyond national borders, and deeper collaborations with the scientific community.

In Switzerland, platforms already exist to facilitate the exchange of knowledge between various actors, such as extra-parliamentary commissions, inter-cantonal conferences, and associations.[294] These fora could be used more extensively for regular and targeted exchanges concerning climate-exacerbated hazards. It could also be beneficial to establish or expand a national knowledge database to which all interested stakeholders have access.[295] This could bring actors who are currently less connected or less affected into the conversation and thus further disseminate knowledge and lessons.

At the European level, such a network exists in the form of the UCP Knowledge Network, through which lessons learnt and best practices are exchanged and made available to all participating countries. By participating in the UCPM, Swiss Civil Protection would gain access to this network, and could benefit from a plethora of information and experience from different European countries.

Expanding trans-regional and international cooperation

Our study highlights that more trans-regional and international cooperation in the field of civil protection is not only advantageous for the exchange of knowledge and experience, but also the development of practical skills, such as exercises, training, and joint deployments. Switzerland's neighboring countries benefit from such cooperation via their participation in the UCPM and other organizations, such as NATO, but also through bilateral agreements. With time and repetition, this can also result in an alignment of the different civil protection services in terms of operational standards, norms, doctrine, and equipment, which enhances interoperability.[296]

The relevance of increased international cooperation for Switzerland to address its civil protection needs was emphasized in the Supplementary Report 2022 to the Security Policy Report 2021.[297] Switzerland does not currently participate in the UCPM or in the civil-military exercises of NATO. However, following a parliamentary proposal in the fall of 2022, the Federal Council made the decision in November 2022 for Switzerland to become a Participating State of the UCPM.[298] This decision was opposed in the National Council, resulting in a vote in the same chamber in March 2023 that was in favor of the Federal Council's decision.[299] Therefore, options are currently being explored by both the EU and the Swiss administration to enable Switzerland to participate in the UCPM, potentially outside of a wider framework agreement between Switzerland and the EU. On the basis of current ties, efforts by Switzerland to participate in the

civil-military exercises of NATO have so far not led to any tangible results.[300]

Despite the value of multilateral cooperation, the experts interviewed for this study still consider bilateral agreements as having an important role to play in disaster management. With the increase in climate-exacerbated hazards, the response capacity of the UCPM has at times been stretched thinly, especially during the summer. The inability to assist everywhere at once means that bilateral agreements in civil protection will retain their relevance, particularly between countries that are in close geographical proximity, or who consistently face similar types of hazards (e.g., the bilateral agreement signed by Portugal and Greece in early 2023). For Switzerland, it could be beneficial to update existing bilateral agreements to accommodate the changing hazardscape with climate change and, where appropriate, create new agreements.

Regionalization of capacities

Addressing the impacts of climate-exacerbated hazards requires, in some cases, specialized capabilities. While these capabilities need to be available, they are usually used comparatively rarely, and it therefore makes little sense for multiple administrative units to all procure the associated equipment. This challenge is addressed in the countries analyzed in our study by pooling such specialized capacities at a regional level, by acquiring them at the national level, or by drawing on the respective capabilities in other European countries via the UCPM.

Similarly, it makes more sense to procure and maintain specialized civil protection equipment regionally (e.g., a grouping of neighboring cantons) or at the national level in Switzerland. The so far little implemented but much discussed idea of inter-cantonal *Zivilschutz* bases could prove useful for adapting to climate-exacerbated hazards. In addition to cost savings and increased inter-cantonal cooperation, the pooling of specialized capabilities could have spin-off results, such as the standardization of training and operational practices across cantons.[301] The location of such bases could be aligned with the strategic pre-positioning of assets in at-risk regions to minimize response time (as is currently happening in France and Austria). This could also apply to national resources via the Federal Resource Management *(Ressourcenmanagement Bund).*[302]

By participating in the UCPM, Switzerland could draw on such assets in other European countries instead of purchasing and maintaining them individually.[303] This would also give Switzerland the possibility to build up and maintain new capabilities with financial support from the UCPM (e.g., rescEU), as long as these capabilities are registered with the UCPM and also made available for deployment abroad. The UCPM also offers financial assistance for the standardization, maintenance, and upgrading of existing national response capacities, if they are then registered as part of the European Civil Protection Pool. Participation also provides access to the Copernicus Emergency Management Service, which offers a range of earth observation resources, including on-demand satellite imagery.

Our study also showed that regionalization is being used in neighboring countries as a strategy to increase redundancy in other climate change impacted fields, such as vital services, which are relevant to civil protection systems (e.g., the consideration of water scarcity due to climate change in Germany's revised drinking water supply strategy). While there have been similar efforts in recent years to consider the interconnectivity of, for example, water catchments in Switzerland, particularly with respect to drinking water supply,[304] it could be beneficial to further increase redundancies in vital services through cooperation, coordination, and networking across regional and national borders.

Adapting and enhancing resources and capabilities

There are three possible complementary approaches to adapting and enhancing civil protection resources and capabilities to climate-exacerbated hazards: an enhanced role of the Armed Forces, an increase of civil protection resources, including the *Zivilschutz,* and by better integrating spontaneous volunteers during crises.

The Armed Forces in all of the countries analyzed already play a role in managing civil protection-related crises. In an emergency, the Armed Forces can provide heavy or specialized machinery and related dual-use services, which are not widely available in the civilian sector, as well as a sustained workforce if required. Thus, the capacities of the Armed Forces function as a strategic reserve to civil protection structures, or as an instrument of last resort in disasters with an unexpectedly high impact or prolonged duration. These functions overlap with the core tasks of the Armed Forces, which is why their integration into respective civil protection systems during a disaster is reasonably straightforward. None of the case study countries, according to our research, intend to expand the role of the Armed Forces in civil protection significantly beyond the current level.

In Switzerland, it could be beneficial to more clearly identify and communicate the resources and capabilities of the Armed Forces, which are available for civil protection related purposes, so cantonal planning processes can take them into account, and to ease access via the Federal Resource Management System during a crisis.[305] More joint training and exercises between civil protection and military actors could also be helpful in improving processes and developing a shared understanding

of how to manage natural hazard-related disasters. The same applies to a better integration of the Armed Forces into the cantonal crisis management structures, for example, through a fixed presence in the cantonal crisis units of representatives from the respective territorial divisions. Should Switzerland participate in the UCPM in the future, it could open up deployment opportunities for the civil protection-related assets and capabilities of the Armed Forces (e.g., the deployment of personnel from the Armed Forces as part of Italy's assistance to earthquake-stricken areas of Turkey). This could boost operational experience and potentially strengthen the Armed Forces' understanding of their role in civil protection-related deployments in Switzerland.

Instead of enhancing the role of the Armed Forces in response to climate-exacerbated hazards, the analyzed countries are integrating new resources and expanded capabilities into their respective existing civil protection systems. Germany and Italy, for example, intend to better integrate spontaneous helpers into their civil protection systems during future emergencies. In Germany and Austria discussions are underway regarding the acquisition of new aerial firefighting resources and new specialized vehicles with, for example, amphibious capabilities. France is procuring additional aerial firefighting resources and training more firefighters that will be deployed to an expanded network of bases strategically positioned in at-risk areas. There is also a growing awareness of the need to take seriously the mental health of civil protection personnel who are exposed to more frequent and intense disasters with longer deployment times. In Switzerland, the *Zivilschutz* already has the organizational set-up with a range of capabilities and operations, which can be expanded relatively flexibly in response to climate-exacerbated hazards. This already strengthens the resilience of its partner organizations, and integrates updated protection measures, such as the adaptations made in response to the devastating floods in 2005 and 2007.[306,307] Further strengthening the resources of the *Zivilschutz,* as well as a possible expansion of its range of services in line with unfolding climate-exacerbated hazards, therefore seems logical.

Civil protection capacities can also be expanded through a greater integration of spontaneous and/or trained volunteers. Germany and Italy have considerable experience in this area. After the floods in Germany in July 2021, thousands of volunteers flocked to the affected areas to help with the cleanup efforts, illustrating both their potential to assist and the challenges of their sustainable involvement amidst ongoing civil protection operations.[308] Trends studies show that young people in Switzerland are more likely to engage in event-oriented, short-term volunteering within loose structures, rather than active and long-term involvement in crisis management structures.[309,310] With climate change, this phenomenon and the associated opportunities and challenges are likely to be increase in the future. To benefit from the potential advantages in a targeted manner, appropriate preparations must be made before disaster strikes, especially at the local level. For Swiss Civil Protection, it could therefore be beneficial to plan for an influx of spontaneous volunteers in the event of a crisis, to consider how to integrate them into the regular structures, and to assess what role they could usefully fulfill. This could involve the provision of basic training in order to maximize the usefulness of spontaneous volunteers, as it is already practiced in Italy.

At the beginning of 2022, Switzerland decided against acquiring fixed-wing firefighting aircraft - at least for the time being.[311] Instead, the suitability of different types of aircrafts for Swiss conditions will be investigated in-depth. This will include consideration of resource availability through the UCPM, and the compilation of an overview of all civilian and military helicopters available in Switzerland today. At present, the helicopters of the Armed Forces are primarily used for firefighting; one helicopter is usually on standby, and another is available on short notice.[312] Some cantons, such as Ticino, also have agreements with private helicopter companies for paid assistance in an emergency.[313] Other cantons rely on the ad hoc use of private helicopters. This system has worked well so far because forest fires in Switzerland have mostly been localized events. In view of the increasing risk of forest fires with climate change, this system is likely to reach its limit soon. Without appropriate contractual obligations, the growing demand for private helicopters and pilots with firefighting experience in Europe, might see these resources deployed abroad in the future when there is a need for them in Switzerland. Suitable arrangements are therefore advisable at the cantonal and/or national level with relevant private companies, as is a potential increase in nationally available resources.

Improving public preparedness and coping capacity

Our study also highlights the urgency of preparing the public – mentally and practically – for both the acute and prolonged impacts of climate-exacerbated hazards on everyday life. The capacity to cope with catastrophic warnings, worrying about friends and family, gloomy news-cycles, poor air quality, water restrictions, travel bans, evacuations, short- or long-term displacement, etc., comes with readiness. It is therefore critically important that we prepare as a society to enable individuals to be adequately prepared for the psychological and practical toll of climate change.[314]

Such efforts would benefit from better coordinated risk communication that is tailored to particular contexts and audiences. Local hazards need to be actively

communicated by the responsible authorities, and for many areas target groups should include tourists and temporary visitors who may not be familiar with local hazards and emergency procedures. Improved risk communication is also a question of the ease with which people can stay informed, such as access to up-to-date information via AlertSwiss,[315] or the development of hazard specific preparedness advice, such as those currently available for emergency stockpiling.[316] These sources could also provide information on ways to volunteer in the civil protection system, or provide information to guide and support spontaneous volunteers during an emergency.

All of these recommendations necessitates that the cantons know their current and predicted risk exposure through regular cantonal risk analyses that take account of how the hazardscape is changing with climate change.[317] Clear risk communication can also assist journalists and media outlets to not just report on the headline-grabbing horror stories of disasters, but to proactively communicate about ways to prepare for, cope with, and support others, and thus instill proactive participation rather than despair and dread.

Optimizing situational awareness and crisis communication

Our study shows that the need for timely forecasting, well-coordinated situation reports, and mobilization of appropriate local capacities at short notice, will continue to increase due to climate-exacerbated hazards. Addressing this need requires smooth crisis communication between all levels of government. Forecasting capacities at the regional/national level is required to anticipate various scenarios, which should be communicated efficiently to all parties, including the public. Experiences in neighboring countries show that local authorities and first responders are not always able to adequately translate warnings from national alarm centers into actionable local preparedness measures, particularly when there are likely to be uncertain further developments. At the same time, local authorities must also be able to integrate their information into regional/national situation reports in a timely and efficient manner.

The alarm chain in Switzerland is comparatively well established and communicates efficiently with the public and between the authorities at the various levels of government. Around 7,200 fixed and mobile sirens are available for public alerts, and their activation is followed by information via licensed radio and TV broadcasters who are obliged to immediately insert public warnings and instructions into their programs.[318] Since 2018, public warnings and behavioral instructions from national and cantonal levels can also be disseminated via the official multi-hazard warning app AlertSwiss, which is relatively widely used and continuously improved.[319] In addition, Cell Broadcast is to be introduced in the near future.[320] In case of an emergency, NEOC compiles a consolidated situation report several times a day from the various relevant sub- and specialist situations. This is made available to the federal and cantonal partners via the Electronic Situation Display (ELD) platform. During the coronavirus pandemic, this worked relatively well, but the recipients of the ELD in federal and cantonal offices could potentially benefit if situation forecasts, trend anticipations, and, ideally, assessments of resources required were also included.[321] Parallel to the ELD, the cantons operate their own platform for the display and sharing of a situation report for intra- and inter-cantonal cooperation in crisis management with the *Lage-, Führungs- und Informationssystem LAFIS*. The creation of (currently non-existent) interfaces between the systems at the two levels of government could create synergies and prevent the juxtaposition of different situation reports in the event of major crises.

Situation analyses by cantonal and federal authorities could also benefit from increased use of satellite imagery and data. High-resolution satellite imagery can be a valuable complement to ground-based information, especially when on-the-ground data during a disaster is incomplete or inconsistent. Incorporating satellite images into disaster analysis can help identify affected areas and prioritize relief efforts, especially in locations with high concentrations of vulnerable populations. Combining space-based imagery with other geospatial data sources, such as topographic data, weather data, ground reports, and population density information could also improve the visual representation of a situation, making it easier to translate complex information. Integrating satellite imagery into the situation report could also assist cost-benefit analyses of large climate change adaptation projects, especially when they involve multiple cantons. Switzerland's neighboring countries already integrate such services into their situation analyses through the Copernicus Emergency Management Service, to which they have access as members of the UCPM.

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