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Concepts,
Doctrine and
Experimentation

PROSPECTIVE



The impacts of climate change on the use of forces by 2050

Joint Forward Thinking
RPIA-2024/001_CLIMAT/FORCES

N° D-24-001896/ARM/CICDE/NP of 18 april 2024



Entitled “**The Impacts of Climate Change on Use of Forces**”, Joint Foresight Thinking (RPIA)-2024/001_CLIMAT/FORCES, meets the requirements of the *Allied Administrative Publication (AAP) 47 Edition C Version 1, February 2019* entitled *Allied Joint Doctrine Development*. It also applies the rules described in the *Lexicon of typographic rules in use at the Imprimerie nationale* (LRTUIN, ISBN 978-2-7433-0482-9), the main part of which is available on the Internet site www.ingroupe.com and the prescriptions of the Académie française.

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RPIA-2024/001_CLIMAT/FORCES

THE IMPACTS OF CLIMATE CHANGE ON THE
USE OF FORCES BY 2050

N° D-24-001896/ARM/CICDE/NP of 18 April 2024

Climate change is one of the great challenges that humanity will face throughout the century and beyond. Its consequences on the physical environment, the biosphere and human societies will be considerable, and we are already seeing the premises with changes in precipitation patterns, rising temperatures and sea levels at the global level. While all regions of the world are affected, as illustrated by the large-scale extreme weather events that have hit them in recent years, some are more exposed than others. Overall, climate change will be a major driver of risks and threats of all kinds and will contribute increasingly to international insecurity and instability.

It was therefore necessary, as part of the implementation of the Climate & Defence strategy, adopted in spring 2022, to develop an in-depth joint reflection on the impacts of climate change on international security and the Armed Forces, and recommendations to address the wide range of challenges in force employment, operational and capability readiness, or force support. This joint reflection will date and will be the reference allowing the armies, directorates and services of the department to decline it in the form of action plans, operational prospective reflections, wargames and various measures, especially in terms of training, so that climate change is integrated into all decision-making processes at the strategic, operational and operational levels.

This is of course a process of adaptation that will be long-term, but there is a real urgency to integrate long time into reflection and present action. Major players in defence, peacekeeping and crisis management, the Armed Forces must adapt resolutely and dynamically in order to remain resilient and be able to fulfil their operational contracts at all times, in all places and circumstances.

Admiral Pierre Vandier
Vice chief of the armed forces
Climate Delegate of the Ministry of Armed Forces
Apr 2024

Letter of promulgation

Paris, 18 april 2024

N° D-24-001896 /ARM/EMA/MGA/NP

Subject: Promulgation of joint publication **RPIA-2024/001_CLIMAT/FORCES (2024)**.

The joint publication, RPIA-2024/001_CLIMAT/FORCES(2024), entitled **Impacts of Climate Change on Use of the Forces, dated 18 april 2024** , is promulgated.

The vice chief of the armed forces
Admiral Pierre VANDIER

Summary of amendments

1. This table is the collection of all amendments proposed by readers, regardless of their origin and rank, sent to the Joint Centre for Concept, Doctrine and Experimentations (CICDE).
2. The amendments approved by the CICDE (Director) are listed **in red** in the table below in their chronological order of consideration.
3. The amendments considered are in **purple in the new version**.
4. The administrative number appearing at the bottom of the front cover and the false cover is corrected (**in Roman, bold, red characters**) by adding the mention "**amended on the day/month/year**".
5. The electronic version of the amended joint reference text replaces the earlier version in all computer databases.

N°	Amendment	Origin	Validity date
1			
2			
3			
4			
5			

NOTE – Request for incorporation of amendments:

6. The reader of a joint reference document who has identified errors, typos, errors in French or English or has comments or suggestions to improve its content, may contact the CICDE by sending them (on the model of the table below) to:

CICDE – Ecole militaire – 1, place Joffre – 75700 PARIS SP 07 or CICDE NEMO: cicde@intradef.gouv.fr

N°	Origin	Subsection (n°)	Sub-paragraph	Line	Comment
1					
2					
3					
4					
5					

Joint National Documentation

- a. ETIA-3.0.5_CCLIM (2021) n°72/ARM/CICDE/NP of 27 September 2021 - *Changements climatiques et enjeux pour les forces armées françaises*. Climate change and issues for the French armed forces.
- b. Defence-Climate Strategy, April 2022.
- c. *Environnement opérationnel futur 2040*. Future Operating Environment 2040, Joint Prospective Reflection (RPIA) n°2022/001, No. 100 ARM/CICDE/DR of 5 July 2022.

NATO Documentation

- a. *Political committee, NATO'S Climate change and security impact assessment AC/119-WP(2022) 0009*.
- b. *Military committee advice on vulnerabilities stemming from the effects of climate change on NATO's strategic environment, March 2023*.
- c. *PO (2021) 0097, A NATO agenda on Climate change and security, 17 March 2021*.
- d. *PO (2022) 0272, report on progress achieved in the Implementation of NATO's climate change and Security Action Plan, 22 June 2022*.
- e. *IMSM-0421-2022 (INV) Military Committee tasking on vulnerabilities stemming from the Effects of Climate Change on NATO's Strategic Environment, 13 October 2022*.

Executive Summary

1. Climate change and its impacts on the biosphere are a «**global challenge likely to feed significant imbalances¹**». Climate change is seen as a **multiplier of security threats** and an **amplifier of existing risks**.
2. This is mainly reflected in the following physical consequences: rising temperatures, reduced cryosphere, rising sea levels, changing precipitation patterns, intensification of extreme weather events (heat waves, droughts, cyclones, torrential floods, mega fires, etc.).
3. These hazards will affect territories, societies and populations through tensions related to access to water, agricultural and fisheries resources, the habitability of certain regions, the opening of new communications routes and new areas of exploitation in the polar regions (mining, fisheries, energy, etc.).
4. Increasing water stress in some regions will affect food security and create intra- and inter-state tensions related to access and control of water resources. The Near and Middle East, the Sahelo-Saharan strip, the Maghreb and Central Asia will be among the areas most affected by scarcity and tensions related to the sharing of water resources.
5. Impacts on food resources are illustrated by:
 - Lower yields and reduced agricultural areas, particularly in East Africa, the Sahel-Saharan strip and the Near and Middle East.
 - Some countries could benefit from climate change in agriculture (Eastern Europe, North America) and through the development of new fisheries (Arctic Circle countries). These countries will increasingly weigh on the evolution of international market prices and will be likely to use food weapons in their international relations, especially in the event of an open crisis.
6. The effects on habitability will affect many territories:
 - a) Rising sea levels in the Indian and Pacific Oceans, West Africa and the Caribbean will lead to disappearing territories and displacing populations.
 - b) In tropical or subtropical areas, as soon as the threshold of +2°C is reached, probably before 2050, high humid heat (temperature wet (Tw)) will make many regions difficult to inhabit (East China, North India and Pakistan, Southeast Asia, West Africa, Northeast South America, Mississippi Plain States, Arabian Gulf, etc.).
7. The melting of ice at the poles will have geopolitical consequences primarily in the Arctic region: easier access to this space will allow the development of new maritime routes and the exploitation of new fisheries and mineral resources. These will be sources of opportunities and therefore of covetousness and tension between countries. Counterintuitively, climate change is expected to lead to more military operations in cold areas. However, the opening of these new routes will have a limited impact on the existing shipping routes.
8. Societal consequences include:
 - a) The question of migration will become even more a major subject of tensions between the countries of departure (mainly sub-Saharan Africa, the Near and Middle East, Southeast Asia and Central America, etc.), transit (Maghreb, Turkey, etc.) and destination (Europe, North America, Southern African countries, South America). Some countries will seek to strengthen the protection of their borders or even to close them, possibly with the support of the armed forces;

¹ *Revue nationale stratégique* published in 2022. English version of FRA National Strategic Review (NSR) at : <http://www.sgdsn.gouv.fr/files/files/rns-uk-20221202.pdf>

- b) The most fragile states and those most exposed to the consequences of climate change will be subjected to crises that will lead to great instability and intra-State tensions or interstate that could lead to armed conflict or the collapse of institutional structures.
9. In general, climate change will amplify and contribute to the multiplication of crises but will not fundamentally change the location of crisis zones where the French armed forces could be called upon to intervene. The new potential conflict zone of the Arctic should be primarily managed by our allies.
 10. The increase in the frequency and intensity of large-scale natural disasters will be such that the means of civil security could prove increasingly inadequate, insufficient or unavailable. The Armed Forces will be increasingly called upon to support them in relief operations and assistance to the affected populations or the evacuation of nationals.
 11. More generally, the superimposition of large-scale natural disasters with security crises linked to socio-economic reasons will lead to an increase in the use of armed forces and a risk of exhaustion of their capabilities.
 12. The conditions of use of forces in certain areas will be more restrictive. The main impact will be on human support, with an increased need for water, food and energy. This will result in an increase in the logistical maneuver that will have to be partially mitigated by the search for greater autonomy of our facilities, particularly in terms of energy and water.
 13. The fragility of the overseas territories vis-à-vis extreme phenomena will require to maintain pre-positioning of forces but especially to have reactive deployment and redeployment capabilities.
 14. Military equipment will not need to fundamentally evolve but:
 - Their operational performance may be affected (aircraft payloads, system endurance, premature wear);
 - The supporting facilities for their use, packaging or storage must be adapted. At the technical level, ship structures will have to consider the increase in aggressions (salinity, swell strength, algae proliferation, etc.);
 - Sea level rise (erosion and flooding) and flooding will be a challenge and will require heavy and costly work on port and airport infrastructure;
 - The maintenance of the equipment will have to be adapted in order to mitigate the increase of the logistic maneuver in particular by a search for a greater sobriety of the equipment.
 15. Operational readiness will need to take into account the new climatic conditions of force engagement. Military intelligence and strategic anticipation must integrate climate risk into their analyses.
 16. Finally, attention should be paid to the regulatory developments accompanying climate change and the energy transition. The regulatory and normative framework must not ignore the singularity and specificity of certain military activities. Indeed, the normative constraint applied without distinction could significantly affect the operational capabilities of the armies. It is therefore necessary to find the right balance between operational constraints and environmental ambition.
 17. Recommendations were adopted on the adaptation of armed forces operations contracts to Humanitarian and Disaster Relief (HADR) missions, the strengthening of logistical capacities and support points, the development of energy and water autonomy, the mapping of vulnerable infrastructures and an adaptation plan with regard to climate phenomena, the continuation of research and development work on human support, the adaptation of capacity processes to climate change.

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1. The 2022 National Strategic Review (NSR) highlights that the impact of climate change is a “global challenge that can fuel significant imbalances².” Its multi-factor consequences will accentuate destabilizing factors and impact security. Indeed, as the NSR recalls «the acceleration of the effects of global warming will exacerbate migratory phenomena, and create new sources of tension, likely to weigh on both Western cohesion and within each country».³
2. Following the enlightening joint theme on «*climate change and issues for the French armed forces*⁴», joint forward-looking thinking should help guide operational responses to the impacts of climate change on all services, agencies and directorates.
3. Climate change is characterized by multiple effects with slow or fast kinetics (warming, droughts, rising water, violent climatic phenomena, deregulation of the precipitation regime...). Climate change is a factor of new security threats and amplification of existing risks. This issue must be addressed by the armed forces in order to adapt the future combat tool.
4. This document discusses the security consequences of change (Chapter 1) and the employment consequences of the joint forces (Chapter 2), in order to better deduce the operational consequences for the Armed Forces, Directorates and Services (Chapter 3) and the recommendations adopted (Chapter 4).

² Revue nationale stratégique, 2022, p.7 (English version at : <http://www.sgdsn.gouv.fr/files/files/ms-uk-20221202.pdf>)

³ Revue nationale stratégique, 2022, p.13

⁴ ETIA-3.0.5_CCLIM (2021).

Chapter 1

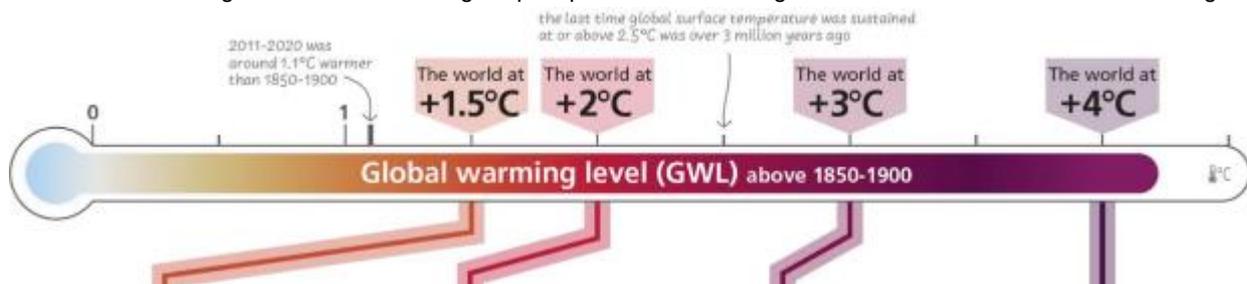
The Security Consequences of Climate Change

101. The result is global warming, with multiple consequences for physical and living environments, access to resources and extreme weather events. The effects of climate change have different timeframes and are unevenly distributed. The impacts of climate change are already observable, their frequencies and intensities will accelerate in the coming years.
102. About 3.3 to 3.6 billion people live in conditions of high vulnerability to climate change. In light of these environmental changes, various factors will impact populations and generate tensions or increase conflict.

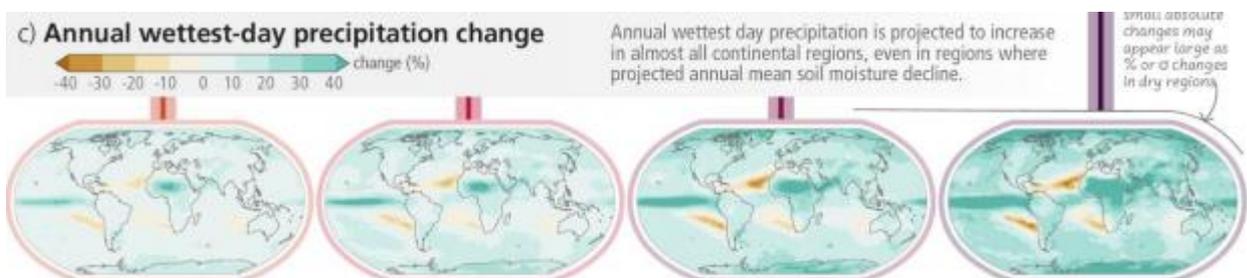
Section I - Water Stress: An Aggravating Factor

Major consequence 1 – Water stress will create intra-State or inter-State tensions due to population displacement and will bring new areas of conflict.

103. In 2001, Kofi Annan, then Secretary-General of the United Nations, stated that “*the intense competition around fresh water could well become the source of conflicts and wars in the future*”⁵.
104. The lack of fresh water will increase tensions. The UN⁶ estimates that 2.2 billion people will be under water stress by 2025.
105. Changes in rainfall patterns affect people’s access to water resources. In some parts of the world (the Andes, the Himalayas), the melting of glaciers amplifies the variations of the rivers ‘flow. The acceleration of their melting will lead to their gradual disappearance and will eventually reduce the water resources of the downstream countries. Salinization of some nearshore areas or coastal groundwater will degrade the quality of the water resource.
106. A warmer atmosphere may contain more water that condenses at altitude and falls back into rain. Figure 1 shows the change in precipitation around the globe as a function of the level of warming.



This change in precipitation pattern varies greatly across regions.



⁵ « *La crise de l'eau ou la perpétuelle gestion des conflits* », Léna Salamé, Responsabilité et environnement, 2017/2, n°86
⁶ <https://www.un.org/fr/global-issues/water>

Fig. 1 - Change of precipitation regime for wet days according to the level of warming. Source: Synthesis of the 6th Intergovernmental Panel on Climate Change (IPCC) Assessment Report, 2023.

107. The drying up of water courses, the drying up of lakes and repeated droughts will accentuate the difficulties of access to resources with the consequences of an increase in tensions. There is already a correlation between rainfall variations and the occurrence of violence. The geopolitics of water already reveals, as supply becomes scarce, many areas of tension around the issues of securing access or pollution of certain aquatic areas.
108. The following map shows the current zones where the water resource factor is a conflict multiplier.

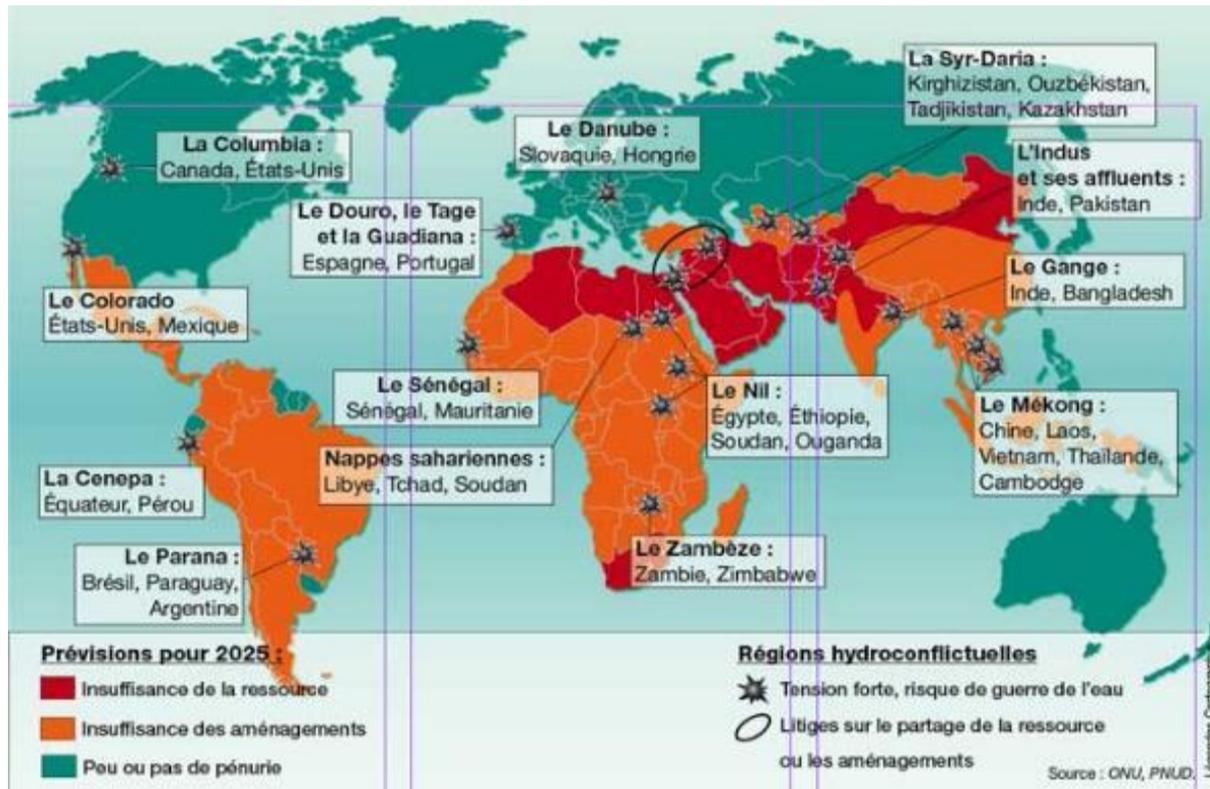


Fig.2 - Mapping of conflict zones related to access to water. Source: UNDP

109. In France, the recurrence of heat waves and droughts imposes increasingly frequent and restrictive restrictions as well as new forms of supply. France has significant groundwater, which represents two-thirds of drinking water consumption and more than a third of that of the agricultural world. These layers may no longer be able to fully recharge, occasionally weakening the capture capabilities.⁷
1010. Regarding the water issue, the *World Resources Institute* has drawn up the map below illustrating the areas where access to water will be a major issue in the coming years. Many affected areas are already subject to systemic instabilities. Without seeking to be exhaustive, current tensions could increase in the following regions:
 - a. Between Egypt and Ethiopia, hoarding of transboundary water resources;

⁷ Groundwater constitutes the main source of drinking water: in France, 62% of drinking water comes from groundwater and 38% comes from surface water (torrents, rivers, lakes, etc.).

- b. Between Israel and the Gaza Strip, the West Bank, Jordan;
- c. Around the axis Turkey – Syria – Iraq for the management of the resources of the Tigris and the Euphrates;
- d. Between China (which controls the Tibetan Plateau) and the downstream countries;
- e. The border between the United States and Mexico.

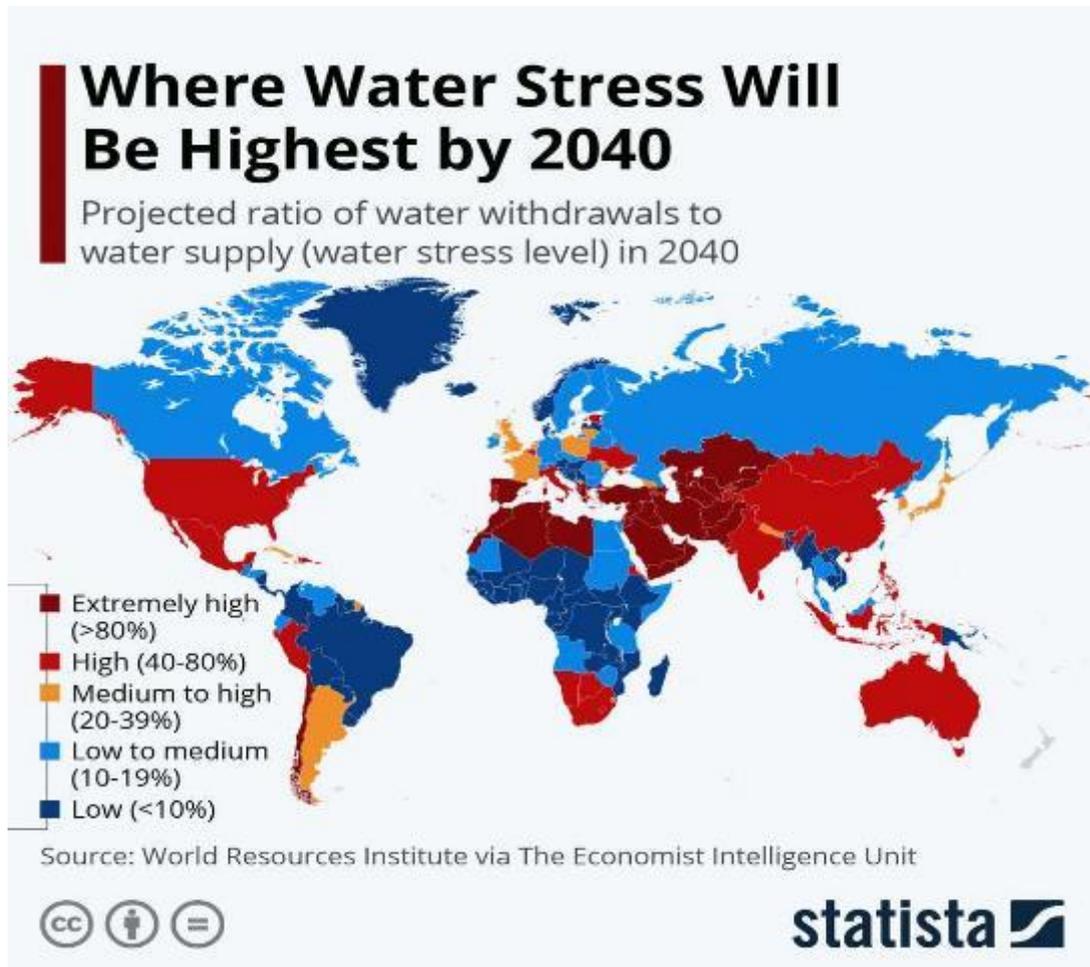


Fig. 3 - Mapping of the most water-stressed countries in the world.
 Source World Resources Institute, 2023

- 1011. The Middle East is the region of the world most affected by water scarcity. 60% of its population live in areas under high water stress. This stress stems from several factors: the scarcity of rainfall, the overuse of aquifers, demographic pressure and unequal water distribution. These water deficits, accompanied by inequalities in the distribution of this vital resource, generate local and regional disturbances. In Asia, water resources are poorly distributed. In this context, dams along major rivers are key infrastructures and are therefore of crucial importance. But they also become subjects of tensions between States for the control of this precious resource.
- 1012. Water stress directly affects agricultural production and therefore food security and can cause large-scale population displacement, as was observed in Syria in the early 2010s and recently in the Horn of Africa.

Section II – Competitions for Access to Resources

Major consequence 2 – Climate change as a risk amplifier will have consequences on access to agricultural and fisheries resources.

1013. Food yields are threatened by climate change, whether in terms of yields from agricultural activities or the volume of fisheries resources. Fishing yields are threatened by ocean acidification and rising water temperatures in addition to overfishing and illegal fishing. This combination of factors threatens the very existence of some fish species and pushes others to migrate to colder or deeper waters. It causes the development of invasive species with sometimes very destructive effects on local ecosystems.
1014. Changes in rainfall patterns, temperatures and the intensification of extreme weather events threaten the yield of agricultural production. These phenomena affect the accessibility, availability and use of agricultural resources. Some major producing countries could benefit from global warming, particularly in Eastern Europe and play an increased role in the global food balance. This scarcity of resources will lead to competition, tension and even conflict. Sometimes the impact is positive, but it remains marginal (for example in Russia or Eastern Europe).
1015. Figure 4 shows the impact of climate change on agricultural and fishing yields, according to several levels of warming and according to geographical areas.

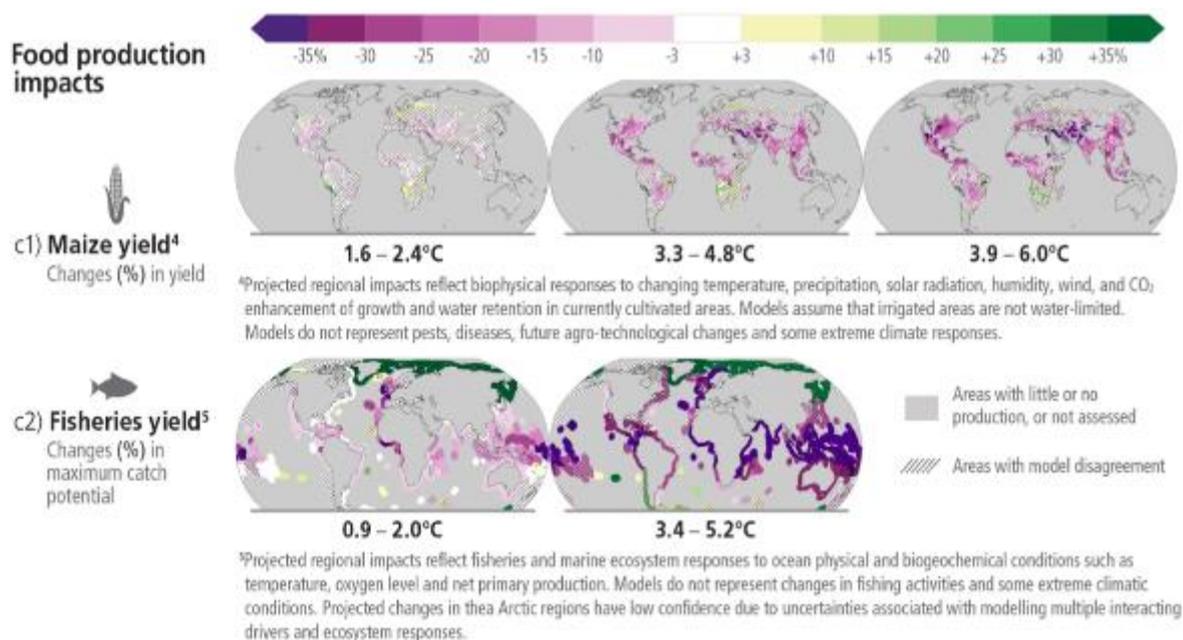


Fig. 4 - Impacts of climate change on agricultural yields and fishing yields according to the level of warming.

Source: Synthesis of the 6th IPCC Assessment Report, 2023.

1016. Extreme weather events can disrupt or even interrupt global supply flows. Floods can have a destructive effect on agricultural stocks and increase the risk of food contamination. Rising temperatures lead to food spoilage and loss of nutritional properties.
1017. According to IPCC experts, 'the rise in global average surface temperature relative to pre-industrial levels affects processes related to desertification (water scarcity), land degradation (soil erosion, receding vegetation, wildfires, permafrost melting) and food security (variation in crop yield, food supply instability). This results in risks to food systems, livelihoods, infrastructure, land value and the health of human populations and ecosystems⁸.'
1018. Emerging countries, which are highly dependent on the primary sector, are particularly exposed to the risks of food insecurity exacerbated by climate change. States already facing periods of

⁸ Intergovernmental Panel on Climate Change (IPCC) Report 2020: Climate change and land surface / Summary for decision-makers.

food shortage are most directly threatened. With the expected decline in agricultural yields, their food situation is expected to deteriorate further in the coming years.

1019. The African continent will be particularly affected, although the degree of severity will vary from country to country. 60% of Africans are already episodically exposed to food security problems and 25% are chronically. As a result of droughts, the cultivation of cereals essential to the continent's diet – wheat, maize, sorghum, millet – is severely compromised. Agricultural yields in sub-Saharan Africa could decrease by 10-20% if the global temperature increase threshold of 2°C was reached or exceeded. If the 3°C threshold was crossed, all areas of maize, millet and sorghum in Africa would become unusable⁹.
1020. The climate vulnerability of the agricultural sector exacerbates competition for agricultural land and generates tensions between different groups. Land grabbing, production and illegal transport of food are increasing, particularly in Latin America. Confrontations can arise in the struggle for access and control of resources. The rise of food insecurity is leading to higher food prices that can be a factor in exacerbating, fracturing and destabilizing states. The inability of a state to ensure its food security can allow armed groups to gain influence. In this case, climate change acts as a catalyst for instability.
1021. Rising temperatures and ocean acidification have a direct impact on biodiversity, fishing areas and the living areas of fish species. The remoteness of these areas with the displacement of fisheries resources in response to climate change, overfishing and illegal fishing will lead to population displacements.
1022. In addition, the alteration of marine currents alters ocean ecosystems and sometimes causes a reduction in average catch weight. Thus, the impact on food security could be significant. Fish resources provide at least 15% of the daily average protein intake to 4.3 billion human beings. By 2050, an additional 75 million tonnes of fish will be needed annually to feed ten billion people¹⁰. Changes in stocks across regions may increase food insecurity.

Section III – Climate Migration: Future Intra-State and Inter-State Tensions

Major Consequence 3 – Intensifying severe weather events, food crises and rising water levels will increase population displacement (within a country) and large-scale international migration.

1023. Let us recall that climate displaced people are “*people forced to leave their place of life because of environmental degradation related to climate change.*” These people are looking for places that are more viable and less vulnerable to climate change.
1024. Most of these movements will take place within national borders. However, several climate factors will be a catalyst for cross-border migration.
1025. Modelling results from the World Bank’s Groundwell reports indicate that there could be as many as 216 million climate migrants by 2050¹¹. Migration on this scale will be a destabilizing factor whose scale risks fuelling tensions and even conflicts.¹²
1026. Rising water levels are one of the triggers for population displacement. Since the pre-industrial era, sea levels have risen by 23 cm and the rate of increase is accelerating. An additional 15 cm increase could increase the population at risk of coastal flooding by 20%. A global elevation greater than 30 cm could threaten some island states or submerge deltaic areas¹³. The gradual submersion of territories of low elevation will lead to claims to maintain the former exclusive economic zones by countries that have lost territories. This could lead to challenges to international law of the sea.
1027. The consequences of climate change will be more severely felt in developing regions, which are less resilient and more vulnerable to hazards. Land degradation and changes in rainfall patterns

⁹ Institut de recherche sur l'élevage, *climate change in Africa: what will it mean for agriculture and food security?* ILRI, 2022, 28 février.

¹⁰ <https://www.un.org/fr/desa/world-population-prospects-2019>

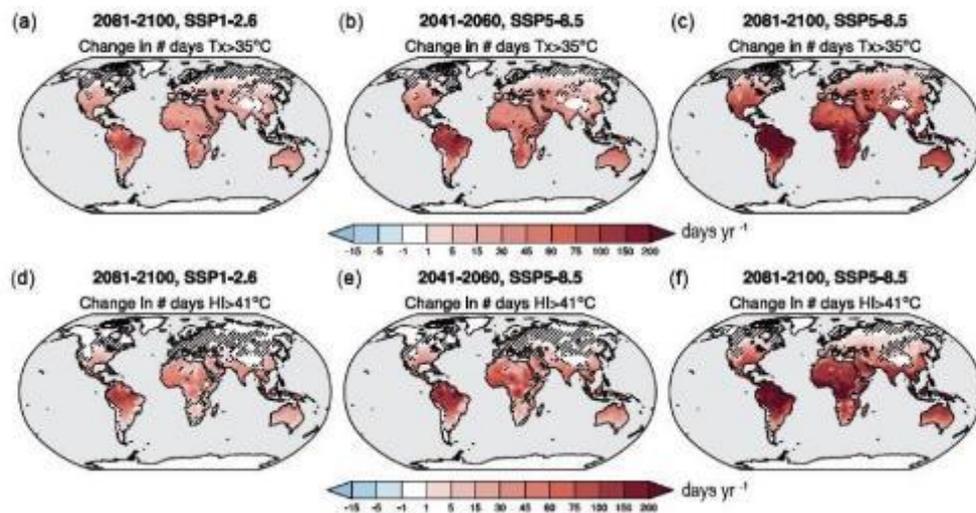
¹¹ 2018 and 2021 reports “Acting on internal climate migration”, International Bank for Reconstruction and Development/World Bank.

¹² Sub-Saharan Africa could register 86 million climate migrants; East Asia and the Pacific, 48.5 million; South Asia 41 million; North Africa 19 million; Latin America 17 million and Eastern Europe and Central Asia 5 million.

¹³ <https://www.noaa.gov/news-release/us-coastline-to-see-up-to-foot-of-sea-level-rise-by-2050>

that affect crops provide incentives for farmers to leave. In the Sahel as in East Africa¹⁴, conflicts between farmers and herders are already common¹⁵.

1028. While much of this migration is expected to remain internal to states, the cases of sub-Saharan Africa, island states, and densely populated areas of the southern coastline-East Asia will potentially see massive population movements in the coming years.
1029. As for North Africa, it is identified as an area of destination or transit of migratory movements. It is expected to experience increasing displacement as the effects of climate change are felt in the Sahel and sub-Saharan Africa. This area will be affected by climate change coupled with increasing migratory pressure. Thus, the loss of habitability of areas affected by resource scarcity could be a factor in intensifying migratory flows to areas less vulnerable to the consequences of climate change.
1030. Political instability, the collapse of state institutions and the imbalance of powers could be consequences of climate-related migratory tensions. Increase in migratory pressure will therefore push many States to protect themselves or to dissuade migratory flows by erecting border barriers, sometimes very sophisticated (*smart borders*). Between 20,000 and 25,000 km of border walls and barriers have already been erected around the world, half of them in the 21st century¹⁶, from North America to East and South Asia to Africa and the Middle East.
1031. A loss of habitability of a territory is likely to feed intra-state or inter-state tensions in case of lack of preparation for climate events. By 2050, some tropical and subtropical areas (Central America, West Africa, the Middle East, South and East Asia) will be subjected to high humid temperatures, making some regions difficult to inhabit.
1032. The increase in heat and humidity potentially threatens people and societies. The “wet heat” index is an indicator to consider when observing wet heat stress thresholds in tropical or subtropical regions.



(a-c) Average number of days per year with maximum temperature above 35°C;
 (d-f) Average number of days per year with heat index (HI) above 41°C.

Source: 6th IPCC Report, Chapter 12, AR6 WG1

¹⁴ À la frontière entre le Kenya et l’Ethiopie en 2019.

¹⁵ Les Dogons et les nomades peuls à la frontière entre le Mali et le Burkina Faso en 2012.

¹⁶ L’Espace Politique « Barrières frontières », sous la direction de Laetitia Rouvière 2013.

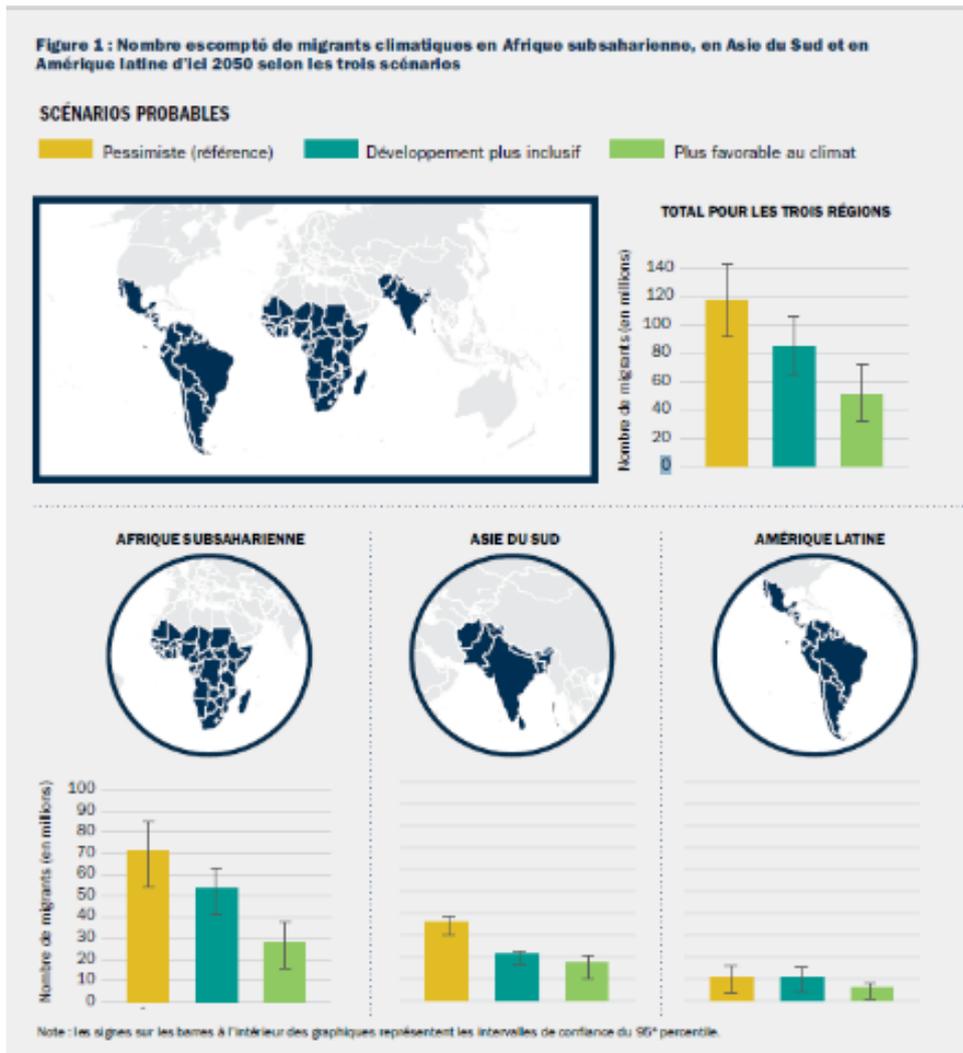


Fig. 5 – Number of climate migrants by 2050

Sources: Groundwell Report ,World Bank 2021

Section IV – Increase in HADR missions¹⁷

Major consequence 4 – The intensification of extreme weather events (floods, tropical cyclones, etc.) will lead to an increase in humanitarian disasters, particularly in the Caribbean and the Indian and Pacific Oceans.

1033. As a result of climate change, natural disasters have increased fivefold over the past fifty years, causing very high human and economic losses. The increase in the frequency and intensity of natural disasters is such that civil authorities should increasingly call on the armed forces to support relief and assistance operations for the affected populations. Increased cooperation between civilian and military personnel in response to natural disasters is already at work internationally in both prevention and response. In particular, it must focus on the prevention of natural disasters and disaster relief.
1034. To cope with a large-scale natural disaster, the Armed Forces will contribute to relief operations requiring specific means and skills (the 4I rule)¹⁸ in order to guarantee support to the populations when civilian capabilities are Unsuitable, non-existent, insufficient, unavailable. While ensuring the permanent defence missions entrusted to them elsewhere. The Armed Forces will be requested by the civil authorities to contribute to relief operations and assistance to the affected

¹⁷ Humanitarian assistance disaster relief.

¹⁸ *Inadapté, inexistant, insuffisant, indisponible*. Unsuitable, non-existent, insufficient, unavailable. From the instruction defining the commitment of the armed forces on the national territory when they intervene, outside the field of military defence, on requisition of the civil authority.

populations. These HADR operations will be carried out on national territory (for example Operation IRMA) but also on foreign territories to evacuate nationals or as part of assistance cooperation (cf. the FRANZ agreement between France, Australia and New Zealand to coordinate humanitarian assistance for the affected States of the South Pacific).

1035. Civil-military actions will become more complex, with interventions in urban and coastal areas where climate degradation factors will combine with the influx of displaced populations. The capacity and resilience of the entire crisis response process should therefore be strengthened.
1036. In the light of the different maps in Annex A, the South-East Asia, the South Pacific, the East Coast of Africa and the Caribbean will be the main places of intervention. In these regions, France has a permanent presence and defence agreements.
1037. France faced a crisis of this type with **the IRMA operation in 2017**¹⁹ in Saint-Martin and Saint-Barthélemy. The Western Antilles were hit by a powerful hurricane. To the force of the winds was added a storm tide causing a sea level rise of more than three meters in some points and strong coastal submersions. Operation IRMA saw the Armed forces act with the other competent services of the State for the benefit of the affected territories according to 4 types of missions:
 - a. Assistance and relief missions to the population (health support, provision of living and bottled water, fuel support, accommodation, clearing roads and decluttering bays, lagoons, marinas and port sites);
 - b. Security mission (as part of the fight against looting);
 - c. Reconstruction support mission (technical assistance from civil authorities, support for emergency deployment, underwater reconnaissance work, opening of communication axes and clearing of bulky, energy production and restoration of the electricity network, infrastructure works);
 - d. Logistics mission (air and sea bridge to the island of Saint-Martin, transport of humanitarian cargo, means available to other ministries, transport of the population).
1038. This operation took place in a joint, interdepartmental and international framework. Operation IRMA highlighted the need for civil-military interlocking. Up to 1,700 soldiers (including more than 400 civil security firefighters) were involved in this operation. This strong mobilization of the armed forces made it possible to establish an air and sea bridge used to transport emergency humanitarian cargo for the benefit of the population (ration, water) and transport by the means of the armed forces.
1039. In the future, it will be necessary to anticipate the increase in requests for assistance or requisition of maritime and air military assets in the context of HADR missions (In and outside of national territory): buildings, air transport means (aircraft, helicopters), and ISR means (Drones, Light Surveillance and Reconnaissance Aircraft).
1040. Interoperability on these types of missions will need to be developed with our allies and partners to meet international HADR missions.²⁰

¹⁹ After hurricane IRMA in 2017, French forces were committed to support the civilian population of French West Indies

²⁰ <https://emergency.unhcr.org/sites/default/files/Guidelines%20on%20the%20Use%20of%20Foreign%20Military%20and%20Civil%20Defence%20Assets%20in%20Disaster%20Relief%2C%20the%20Oslo%20Guidelines.pdf>

Chapter 2

Consequences for the use of forces

201. Climate change and its security consequences require adaptation measures in terms of operational readiness, prevention, response and resilience of the department's armies, branches and services.
202. These measures are part of a doctrine, which includes specific organization, equipment and support. They rely on appropriate training and training.
203. The DOTMLPF²¹ approach has made it possible to identify relatively comprehensively the consequences of climate change for the use of forces. It thus made it possible to collect the various orientations whose conclusions are presented *below*.

Section I - Doctrine and Organizations

204. Climate change is an amplifier of risks and threats at all levels. *A fortiori*, they can also generate new ones and lead to more frequent use of the armed forces.
205. The services, directorates and departments of the ministry are all concerned by the consequences of climate change and must integrate the climate parameter in their work and operational activities. Some concepts and doctrines include, in part, these consequences in particular within the Army²², the Navy, Energy and POL service²³ or military health service²⁴. This consideration must now be deepened and systematized by all armed forces and directorates.
206. Climate change must be considered now in long-term weapons and infrastructure programs.
207. Consideration of climate risks in operational planning processes should be broadened and deepened.
208. It will be necessary to take into account the normative and regulatory evolution accompanying climate change on the missions of the Armed forces and therefore the adapted framework to be put in place to preserve them. To meet their commitments, the Armed Forces must be able to benefit from a number of exemptions and exemptions, and be authorized, in certain circumstances, to adapt certain standards according to a risk control approach. Ignoring such a need poses the risk of regulatory asymmetry and "unilateral disarming by law and standard" for the benefit of our strategic competitors who are often less concerned about environmental protection.
209. In order to take into account, in particular, extreme, increasingly intense and frequent weather events and rising temperatures, the Armed forces must mobilize their specialized organizations. They will need to be more involved in operational planning by analyzing and exploiting climate and weather data.²⁵
210. Better consideration of climate change and sobriety measures are to be developed through organizational adaptation. Consideration could be given to expanding the Joint Local Water Energy Committees (CMELs) to include energy resilience issues and consideration of climate risks.

²¹ Doctrine, organization, training, materiel, leadership and education, personnel, and facilities

²² *Concept d'emploi des forces terrestres en montagne* (EMP 10.43 du 19 juillet 2006); *Doctrine d'emploi des forces terrestres en zone montagneuse* (EMP23.431 du 8 juin 2010), *Doctrine d'emploi des forces terrestres en zones désertique et semi-désertique* (EMP20.440 du 18 janvier 2013); *L'emploi des forces terrestres en opérations grand froid* (DFT 3.2.17 21 septembre 2022).

²³ DIA 4 Soutien en opérations. (FRA Joint logistic doctrine.)

²⁴ The military health service (SSA) provides health support to the armed forces at all times, all places and all circumstances. The 2014 medical support doctrine for operational commitments (DIA-4.0.10) takes into account the management of infectious risk and exposure to extreme climatic phenomena. As the COVID crisis has illustrated, the SSA can be called upon to support the armed forces to carry out missions for the benefit of the population. Concerning a contribution for the benefit of climate refugees or populations victims of an extreme climatic event, the SSA can be requested to support the Armed Forces. Taking into account the contribution of the Armed Forces to an exceptional health situation on the national territory through a protocol with the ministry in charge of health was updated in 2022.

²⁵ Service Hydrographique et Océanographique de la Marine, Centre d'Expertise Météorologique et Océanographique de la Marine, Centre Météorologique des Opérations aériennes, Centre Interarmées de Soutien Météo-océanographique des Forces.

211. Military intelligence will integrate new security threats related to climate change into its analysis and expectations.

Section II – Missions and operational contracts

212. The security threats associated with climate change detailed in Chapter 1 introduce new operational challenges for the armed forces. The multiplication of severe weather events, rising temperatures and rising sea levels do not lead to changes in the nature of the missions to be carried out, but have consequences on the operational contracts of the armies.
213. The Armed Forces will see the level of engagement increase with the onset of increasingly frequent climate crises.
214. The question of the adaptation of the capacity format will arise from the intensity of the consequences of climate change. The format seems to be adapted to «the 2035 environmental horizon». The study of the adequacy of the system (number, capacity, distribution, qualifications, resilience, etc.) to future situations will have to be regularly conducted to make any re-assessments and avoid exhaustion.
215. The directorates and services ensure the support of the armed forces (in the areas of health , Ammunitions, energy, CIS , food..) at all times, in any place and in all circumstances, including in the most extreme environments. They will be particularly impacted by climate change in their jobs.
216. The intensification and multiplication of extreme weather events will lead to an increased demand for military assistance for the benefit of populations in the in and outside the national territory. It will thus be necessary to provide for the adaptation of the operational contracts²⁶ of the armed forces in order to guarantee effective and reactive response capabilities in demanding environments.
217. The increase in the employment of the armed forces in the function of territorial protection (civil security, logistical and medical capabilities projected) and populations could have consequences on the pre-positioning of resources in addition for example, and on reactive deployment or redeployment capabilities.
218. The multiplication of interventions under short notice will require an adaptation (equipment, procedures) of the organization to meet the challenges and challenges brought by the new commitments of the armies.
219. In this context, the Armed Forces may be required to devote human, material and capability resources to these missions, mainly in dual functions such as engineering, logistical support or transportation of people, with assistance and evacuation capabilities and deployment support units.
220. The increase in “assistance to populations” missions will have an impact on the profile of the staff involved. The expected skills will be in terms of crisis management, logistical support, engineering, transport, energy resilience.
221. Crises related to food insecurity will lead to an increase in air, road and maritime bridge missions in an unstable environment (insecurity, infrastructure degradation, health context, weather conditions).
222. Changes to the coastline will require a revision of the reactive charts.
223. The Arctic will be a strategically important area at the crossroads of international lines of force. Counterintuitively, climate change is expected to lead to more military operations in cold areas. Our allies in the Arctic Circle will be involved in these areas. However, the French Armed Forces must be able to operate in support of this region.

²⁶ The commitments of the armed forces, whether permanent or incidental, are translated into operational contracts fixed by the CHOD to the armed forces, directorates and joint supporting services. For each strategic function and by type and duration of commitment, they define the objectives of operational capability availability, allowing the planning of the use of forces and their organic preparation. These contracts are set out in a dedicated document drawn up by the Joint Staff, updated regularly.

224. Ice-free navigation in the waters of the Far North represents:
- A questioning of a certain discretion of submarines;
 - A new maritime crossing to be protected in case of growth of commercial transits;
 - The potential opening of large, contested fishing areas after the likely shift of fisheries resources to colder waters;
 - Growing needs in means of forecasting (predictive models), navigation (including air) and communication.

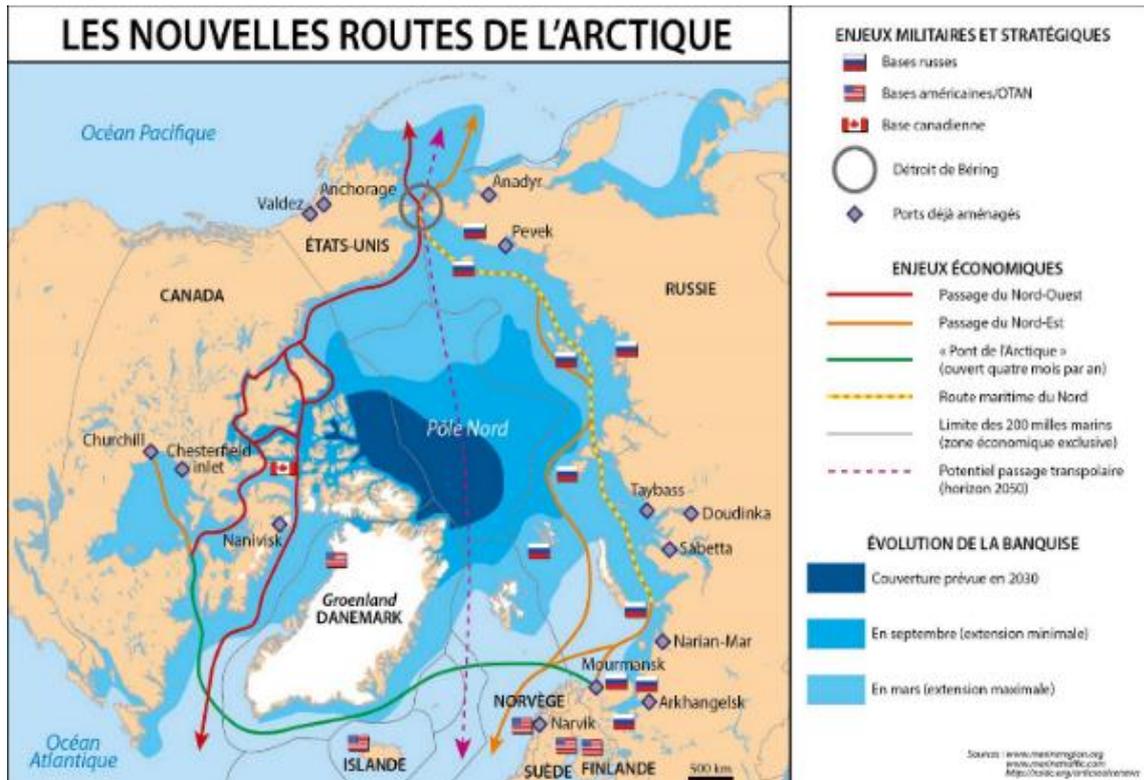


Fig. 6 -

Military and strategic issues with new Arctic shipping lanes. Source: marineregions.org

225. The global rise in temperatures could significantly modify the movements of large ocean water masses with environmental consequences on the great thermodynamic and halieutic balances. In addition to the climatic impacts related to the disruption of major marine currents, this modification of the thermohaline circulation, combined with the acidification of the oceans, will have an operational impact on navigation and detection capabilities under the sea.
226. The weather environment will be increasingly stressful for men and equipment (wind, rain, mud, heat, cold). Aircraft, ships and land vehicles will need to be adapted to degraded mobility conditions. The terms and conditions of employment of the forces to allow their long-term presence will have to be revised.
227. The current operating ranges of the force equipment allow to evolve in extreme conditions. However, vulnerabilities could appear for certain capabilities and lead to new needs.
228. The Armed Forces will have to create and maintain partnerships with countries that can offer the necessary climatic conditions for their preparation, maintenance of their skills and operational deployment.

- 229. Extreme weather events will hinder the fulfillment of the support chain missions. Operational supply routes will be disrupted. Force mobility and capability will be hampered. The planning of exercises and their conduct will have to integrate and anticipate these phenomena.
- 230. Climate events will also affect logistics flows, equipment and raw material suppliers around the world and therefore potentially domestic supplies.
- 231. The decrease in local water availability increases operational costs and impacts the ability of forces to carry out their missions. Additional logistical demand is required due to the complexity of supplying water to remote, hard-to-reach theatres and hostile terrain. The need for bottled and sanitary water will become increasingly prevalent in theatres in hot or very cold areas. Stock volumes will increase to account for the adaptation of water requirements to these high temperatures.
- 232. The continuous development of bottled water supply and storage capacities will in the short term need to be relayed by sustainable, innovative solutions in order to minimize the logistical footprint of the forces. An effort on the water autonomy of the combatant must be developed (e.g. atmospheric water generators).²⁷
- 233. In addition, climate change can aggravate the impact of 58% of pathogens that have already affected humanity. These changes will increase the risk of military exposure to infectious agents, both in mainland national territory and in operations.²⁸
- 234. Climate change can also have significant impacts on munitions and their storage. Variations in temperature and humidity can compromise the chemical stability of explosives, increasing the risk of accidents. Flooding can threaten storage facilities and complicate ammunition logistics.

Section III – Training and Training

- 235. Training modules on climate change must be set up in military schools, and units, in order to increase risk awareness and a fair understanding of the threats resulting from climate change on equipment, equipment, training and operational capabilities.
- 236. Specialized units and training centers exist in equatorial desert, forest or lagoon. They will support the training and training of the armed forces. Their training formats and capabilities will need to be reviewed accordingly.²⁹
- 237. Cold and desert training with our allies is regularly organized and must continue.
- 238. It will be necessary to develop the know-how of assistance to the populations within all the armies.
- 239. It is necessary to practice regular reactive deployments. In an interdependent international system, these trainings will likely require the involvement of other ministries and strategic partners.
- 240. Periods of heat and drought have a significant impact on training areas. Training periods will be limited and will result in restrictions on the use of ammunition and explosives. These spaces must be adapted in order to limit employment restrictions and offer secure areas for troops, but also to allow rapid action in the event of a disaster to limit the consequences both on their availability and on their environment.
- 241. The forces already have expertise in meteorology, oceanography, hydrography. An analysis will have to be conducted to determine whether this resource should be increased in number, qualification and competence. The current forecasting models for these three areas will probably need to be thoroughly revised.
- 242. New areas of expertise are likely to emerge as polar navigation. They will have to be identified and quantified.

²⁷ Today up to 10L/man/D in the Sahel-Saharan strip.

²⁸ Mora, C., McKenzie, T., Gaw, I.M. et al. *Over half of known human pathogenic diseases can be aggravated by climate change*. Nat. Clim. Chang. 12, 869–875 (2022). <https://doi.org/10.1038/s41558-022-01426-1>

²⁹ 27e BIM; ENU MGA; Unités en zones tropicales.

- 243. The increase in the number of HADR missions will lead to the development of know-how related to energy and water production. This know-how now held by civil security will have to be shared with the Armed Forces.
- 244. Maintaining a sustainable environment for staff and equipment requires energy-intensive systems (air conditioning, cooling, heating systems, etc.). Energy needs will increase, leading to an increase in overall cost and greater pressure on the logistics function, frugality and reliability of energy infrastructure.
- 245. In order to deal with the risks of natural disasters, a joint energy/water support coordinator function was set up. On the national territory, local referents for energy, environment, water and climate are trained and set up. An operational energy training module is set up by the energy service at the Joint Oil Base (BPIA).

Section IV – Armaments Equipment and Programs

- 246. When communication equipment, clothing and ammunition are exposed to thermal stress, they may suffer technical failures resulting, for example, from overheating or dust ingress. The decline in staff productivity forced to work in an environment of more than 40 degrees is proven. Equipping forces with materials and systems more resilient to high thermal amplitudes, extreme temperatures and their indirect consequences requires a new sizing of air conditioning/ fridge-air/ refrigeration systems of premises and equipment, and further development of clothing. Premature wear of over-stressed air conditioning systems and sensitive electronic components is observed.
- 247. Ecodesign and “climate design” requirements should be integrated into future capability development processes, adapting them to the military specificities of each equipment.
- 248. The consideration at a good level of ecodesign/climate-design criteria will contribute in particular to the acceptability of major investments to be made.
- 249. The increase in temperatures will lead to limitations in machine performance (thermal, electrical and electronic) and an increase in consumption. Cyclonic phenomena but also drought will cause malfunctions of equipment and facilities, occasional or permanent.
- 250. All of these climate-related changes will have an impact on operational maintenance: they may require more regular maintenance, impose shorter life cycles and involve more frequent renewal or modernization decisions.
- 251. The fighter’s outfits must allow to continue to fight as long as possible in a hostile environment. The goal is to promote or maintain physical well-being, reduce or eliminate the impact and impact of extreme temperatures on the combatant.
- 252. The multiplication of the missions of the armed forces alongside the other competent departments of the State, in particular in case of intervention under short notice and, potentially, in a degraded context (power cuts, access routes and communications due to extreme weather events) will mechanically lead to an increased need for commercial space services. The markets will have to be sized and renewed accordingly.

Section V – Energy Policy and Infrastructure

- 253. The implementation of the operational energy policy is based on the principles of energy sobriety, consumption efficiency and security of supply. Its objective is to contribute to guaranteeing the forces their indispensable mobility, deployment and the use of their weapons systems, in all circumstances. During their employment in operation, the Armed forces are brought «to consume better, less, and safer». ³⁰
- 254. The Armed Forces face a triple constraint:
 - a. That of the lesser availability of oil resources within a few decades;

³⁰ PEO 2022 *Politique de l’énergie opérationnelle* - Operational energy policy D-22-000672.

- b. The need to reduce their consumption of fossil energy;
 - c. An increase in their missions due to increasing geopolitical tensions and violent and more numerous climatic phenomena.
255. The capacity development will *have to* «ensure, for the major equipment of the armed forces, of the permanent adequacy of the couple usable energy/ available energy³¹». In fact, the energy component should be integrated into the capacity development throughout the life of low consumption will be integrated, in order to develop frugal materials and adopt sober behaviors. programs.
256. Operational energy needs will increase, in particular, due to the development of digital technology and the demand for air conditioning necessary for the operation of systems.
257. Forces must be able to express and maintain their current and future energy needs by adapting them to global warming. Studies must be continued on the energy and water sobriety of the camps and projected bases.³²
258. In order to strengthen the energy autonomy of the camps and bases in operation, the deployment of renewable energies (solar, wind, nuclear (*Micro Modular Reactor* or MMR)) must be developed.
259. On the energy front by 2040, the Armed Forces will remain dependent on fossil fuels to run their systems, including ships and aircraft. Light land vehicles are more conducive to the integration of new energy technologies (electrification, hydrogen, etc.). The single fuel policy will remain the keystone of energy support operations. Aviation jet fuel will remain available and the *Single Fuel Policy* will be systematically adopted for land vehicles operating on hydrocarbons.
260. The need for continuity of operational activity and the strengthening of the energy resilience of the armies will be accentuated because of the operations to be carried out potentially in areas where refuelling could be limited or intermittent. Thus a momentary unavailability linked to violent climatic phenomena would lead to a supply rupture. Armed forces must be able to regenerate emergency support chains and have regional logistical support points.
261. Rising sea levels and threats of flooding of port and airport infrastructure could limit access to some current support points (SPOD/APOD). Thus it would be necessary to carry out a mapping of the different sites at risk and to initiate the safety work.
262. Infrastructure must be hardened to withstand the multiplication and intensification of weather events, including floods, winter storms and cyclones.³³

³¹ PEO 2022 Politique de l'énergie opérationnelle D-22-000672.

³² PEO 2022 Politique de l'énergie opérationnelle D-22-000672.

³³ Hangars, aeronautics, radars antennas

Chapter 3

Effect on the Employment of the Armed Forces, Directorates, Supporting Services (ADS)

Section I - Navy

Doctrine

301. The fleet is faced with rapid and sustainable variations in the environment, particularly affecting the conditions of aeronautical navigation and the implementation of its combat systems whose high-resolution sovereign GHOM data requirements are growing.³⁴
302. The maritime environment is subject to significant changes that are amplified by climate change. These requirements are integrated and will be continuously adapted to changing environmental issues, including the intensification of extreme weather events. The Navy's policy of environmental security anticipation is divided into three parts:
- a. **Observe and plan for:**
- (1) Exploitation and exploitation of internal environmental databases to³⁵ quantify and model in order to establish a solid base of knowledge constituting the basis for relevant analyses and forecasts. The Navy relies on the SHOM, the military meteorological and oceanographic chain as well as measurements and surveys at sea. As part of its defence mission, Météo-France supplies the armed forces to conduct its operations through the Joint Forces Meteorological and Oceanographic Support Centre (CISMF).
 - (2) The creation of partnerships based in particular on the SHOM with: the French Development Agency, *Météo France*, the national centre for scientific research, the French Research Institute for the exploitation of the sea, the French Polar Institute, the French Biodiversity Office and Mercator Ocean.
 - (3) The creation of a library of LLs on rescue operations following natural disasters, response to marine pollution, fight against illicit trafficking and fisheries control.
- b. **Prepare to:**
- (1) To be robust and resilient in the face of environmental change, evolving equipment, infrastructure, operational arrangements and procedures.
 - (2) Adjust the means (organization, distribution and alert of units, etc.) to be able to respond to crisis situations (HADR, NEO etc.).
 - (3) Take into account the increase in the volume of loads of certain «key» vectors (aircrafts and helicopters carriers, specialized support ships...) and avoid premature consumption of their potential.
- c. **Cooperate to:**
- (1) To remain in a position to intervene wherever French interests are concerned and to act as best as possible with available means and appropriate support points.

³⁴ Data geography, hydrography, oceanography, meteorology.

³⁵ The knowledge and anticipation of the evolution of the marine environment and coasts for the benefit of the Navy is essentially ensured by the Naval hydrographic and oceanographic service (SHOM), which exploits for this purpose the means made available by the Navy.

- (2) Support political action to preserve the environment (monitoring and control of maritime approaches, fisheries, marine and atmospheric pollution in the prevention and repression).
- (3) Respond effectively to climate events: conduct and participate in pollution control operations, HADR including citizen evacuations, Search and rescue.
- (4) Support the coordination of the interventions of multiple actors, state or not, national or international. Cooperate for better efficiency and limit the human, material and financial impact on the navy.

Missions

- 303. The Navy ensures the reliability and accuracy of its understanding of meteorological and oceanographic phenomena to preserve its freedom of action, optimize its operational efficiency and take the lead. This allows its ships to navigate safely, its air forces to deploy on all the seas of the world, its submarines to blend discreetly into the environment, track their targets and optimize their weapons systems. The additional half-nautical range of the sensor, the extra hundredth of detection, the handful of minutes, even seconds, of reaction can cause the engagement result to change. To this end, the Navy continues to integrate, through the knowledge and anticipation function, the effects of climate change and its impacts on its operations.
- 304. The multiplication of exceptional weather phenomena prematurely erodes structures and complicates operations. Taking the environmental paradigm into account in the Navy's operational planning process corresponds to an already well-tested reality. The planner integrates the environmental fact into the plans of operations as obligations and restrictions but also as a multiplier of effects. The decision maker validates and weighs this plan throughout the design, planning and conduct process.
- 305. In addition to deploying meteorological and oceanographic specialists on its leading ships for local adaptation (Helicopters carrier in particular) a need for better resolution and updating of environmental modelling appears with the following phenomena:
 - a. An increase in global temperature and ocean masses;
 - b. An evolution of bathythermia and salinity of oceans and seas and as a consequence of the propagation of acoustic waves;
 - c. Acidification and hypoxia of the water which changes the absorption of sound waves and consequently the sonar performance;
 - d. Changes in the thermo-haline circulation would challenge our underwater detection models;
 - e. Alteration of sea currents in trajectory, force and depth;
 - f. An increase in sea level, therefore, of flooding, erosion and submersion with a change in the physical configuration of the coastline;
 - g. Melting of the cryosphere (and access to Arctic routes);
 - h. Reduction of krill and zooplankton masses; proliferation of invasive species (sargassum algae) and massive bioluminescent blooms;
 - i. Animal migrations including fish species;
 - j. Extreme weather events, an intensification of cyclones and a change in their trajectories, seas and stronger winds;
 - k. A sharp decrease in humidity or intense rains modify the propagation of electromagnetic waves;
 - l. A modification of the swell profiles (imposing a modification of the margins of stability and fatigue in shipbuilding).

306. To this end, the Navy is preparing to:
- a. Adapt vessels and train crews for ice navigation;
 - b. Strengthening the fight against illegal fishing in our EEZs;
 - c. Anticipate limited access to some ports due to more restrictive environmental legislation;
 - d. Deploy on short notice with amphibious means over long periods to assist in areas affected by extreme weather events;
 - e. Conduct meteorological, hydrographic and oceanographic measurement campaigns for the benefit of the Procurement Agency defence technology projects in order to anticipate the technological breakthroughs that will be necessary to adapt to these phenomena.

Training, exercises

307. In terms of training, the Navy's forward-looking work will focus on:
- a. The formation of a pool of ice pilots to navigate in polar areas. The organization of adequate training for the benefit of the forces in the schools and centres of the Navy (Naval Training Centre, Naval School);
 - b. The multiplication of amphibian training in the context of HADR operations;
 - c. The acquisition of expertise in humanitarian assistance or climate crisis management;
 - d. Exercise POLARIS paves the way for tactical innovation and engagement in new areas of conflict.

Equipment

308. Extreme conditions cause operational limitations. In this logic, the Navy will seek to anticipate its vulnerabilities. Stronger seas and stronger winds will test the platforms harder. Thus, certain architectural and design considerations could be questioned.
309. The availability of the Navy's operational capabilities will become an essential prerequisite for its performance but also its responsiveness to the risk of increased operational commitments or crisis management interventions. This availability will be all the more important as a significant part of climate change crises will be characterized above all by their relative unpredictability, their suddenness and/or their intensity.
310. The equipment and systems implemented by the Navy will have to be designed to achieve the levels of resilience necessary to carry out its missions (resistance, «easy maintenance», scalability, energy efficiency). They will be used in a wide spectrum of operations with varied environmental conditions (humidity, temperature, salinity, wind, etc.).
311. Stronger seas and stronger winds will test the platforms harder. Thus, some architectural and design considerations could be questioned.
312. Strengthened national or international environmental normative constraints will limit access to certain zones or ports (multiplication of *Emission Controlled Areas*) but will also require costly capacity developments or complex exemptions or substitutions. For example, the use of carbon fuels, fluorinated refrigerant gases will increase, which could require the maintenance of a specific industrial chain or regulatory exemptions.
313. The proliferation of algae such as sargassum in the Caribbean Sea is favoured by the warming of the seas and oceans. This phenomenon, which occurs in very hot waters, causes an increased risk of clogging of seawater aspirations for cooling machines, fire safety and the production of fresh water, which requires efficient filtering devices and regular first-level maintenance actions.
314. It will be a question for the Navy to rethink the means, the modes of action, the norms and the devices while taking into account the risks: of wear of dispersion, of exhaustion of the means;

inadequate high latitude navigation and communications combat systems, inoperative platforms and equipment (frost resistance in new accessible polar areas, level of hull reinforcement, performance declines in warm waters).

315. The increased salinity of the water affects the buoyancy of the submarines. The acidification of the waters and the increase of the salinity have consequences on the alteration of the hulls and their nautical performances. The performance of underwater sensors and communication devices are also affected.
316. Sea level rise, which increases the risk of flooding, erosion and submersion, will require expertise and then adaptation work on certain naval base infrastructures to avoid flooding of all or part of the facilities.
317. The Navy's capability work incorporates the need to:
 - a. Resize air conditioners/refrigerators, room and equipment refrigeration system;
 - b. Adapt ships to operate more freely in high latitudes in all seasons;
 - c. Develop warm zone clothing and upgrade basic protective clothing;
 - d. Have high-performance prediction systems and models to optimize the performance of equipment and weapon systems (the maximum depth of immersion of sonars for example);
 - e. Provide all warships with effective protection against organic fouling in warm and coral waters;
 - f. To improve the knowledge of the evolution of the swell and to develop systems of stabilization of the ships;
 - g. Design heating systems for navigation in cold areas.

Section II - The Army

Doctrine

318. The Army identifies climate change, and the resulting energy transition, as a phenomenon that brings geopolitical, energy, demographic and economic destabilizations. It generates new power relations, tensions and conflicts because its effects affect the fundamentals of relations between peoples.
319. Army is aware of its role in the conduct of actions to combat the causes of climate change and the implementation of measures to adapt to its consequences: it integrates climate change as an input into its strategy. Adaptation to climate change, like mitigation and control actions, cannot have the consequence of constraining its operational capabilities, and therefore its ability to fulfill its missions.
320. The challenge for the Army is to adapt better and faster than its competitors and opponents, so that the impacts of climate change on the battlefield (on environmental control, equipment, men) are anticipated.
321. The increase in the occurrence of extreme weather events will lead to a consolidation of partnerships with actors expert in weather forecasting and an evolution of military planning methods so that they are well integrated at the level strategic (on the choice to intervene and the definition of the resources devoted), at the operational level (on the choice of locations, logistics, etc.) and at the tactical level (on the reaction and modes of action).

Missions

322. The Army has a long experience of fighting in extreme environments. From the very low temperatures to the desert climate through the lagoon environment, the Army has always evolved in abrasive environments. Nevertheless, it will have to devote more time and resources to its operational preparation in order to acclimate its forces to these conditions and to environments that have hitherto been little or not accessible (far North).
323. Army interventions will potentially occur in more demanding environments, due to the increased frequency and intensity of extreme weather events on the NT or abroad. In addition, the army must integrate the probability of simultaneous interventions, HADR, NEO and/or oversea operational deployments which reinforces the requirement for joint, interdepartmental, combined cooperation capabilities in a coalition with or without NATO, or with NGOs.
324. To improve its ability to last and limit its logistical and environmental footprint in an operational performance objective, the Army will continue its investment in research and innovation to limit its environmental footprint in oversea operational deployments (energy sobriety, autonomous energy production, drinking water production, etc.).

Training, exercises

325. To meet the full spectrum of Army units' engagement and maintain strategies for access to all airborne environments, it will be necessary to strengthen training partnerships with our allies, to enable the training of forces in extreme environments (hot and cold), including in HADR or NEO missions, ensuring interoperability and complementarity of equipment.
326. The Army will intervene in a degraded context of extreme temperatures of more than 50 degrees during the day and «wet heat» which will cause physical and mental health risks for the soldier. The same is true for cold conditions. Soldiers' training will have to incorporate these more restrictive climatic conditions.
327. Extreme weather events may cause the degradation or even the unavailability of airport or port infrastructures necessary for the projection of military means or assistance. In order to prepare for these scenarios, amphibious know-how will have to be better mastered and shared with other services. Interventions on the ground (combat, assistance to populations) will have to be conducted without assurance of the permanence of air support.

Equipment

328. Constant attention to standards is essential to avoid the risk of a «standards wall». It is a question of safeguarding the specificities of the armed forces by the benefit of derogatory standards as needed, as long as the standard carries a risk of operational decommissioning, an inadequate logistical burden and a cost of ownership.
329. The army intends to invest in identifying the vulnerabilities of its infrastructure (technical buildings, living and accommodation buildings). The aim is to ensure the resilience of parking spaces, including in oversea operational deployments, to extreme events, considering the fragility of the civil environment. In this context, special attention will be paid to the provision of drinking water (in conjunction with the department's water plan) and energy.
330. This vulnerability will be anticipated to take into account the potential evolution of the parking environment (occurrence of exceptional events, water resources, fire risk during shooting campaigns, incompatibility with certain activities – airborne operations for example-). This will include a reflection on the vulnerability of certain settlements in mainland or oversea.
331. A reflection will be conducted on the long-term viability of certain training spaces about their full capacity to meet or not the training requirements (limitation due to the fire risk, nature of the vegetation cover, etc.).
332. Faced with these challenges, the adaptation of the fighter's equipment will contribute to his level of commitment and his ability to last on the battlefield. It will be necessary to continue the effort in research and innovation to develop new ranges of more specialized equipment, and mitigate the consequences, in terms of carrying by the fighter, of a more demanding environment (example: carrying drinking water, drinking water production capacity, etc.).
333. Climate change brings about gradual or more sudden changes in the environment in which the Army operates, especially during exceptional events. These modifications may lead to more rapid adaptations of equipment (means of camouflage, means of crossing, etc.), for example:
- a. Thermo karst – a type of landscape produced by melting permafrost – increases wetlands and creates more challenging terrain for land forces;
 - b. Changes in vegetation cover (lower density and/or height of forest or vegetation cover) impact the ability to progress to cover and camouflage methods.
334. Changes in the rainfall regime and associated phenomena (floods, etc.) could also modify or impede the terrestrial operational framework, particularly concerning transport and crossing capabilities.
335. For the maintenance and because fossil fuels will still be part of the mobility of the armed forces for a long time, the Army intends to prevent the risk of loss of skills related to the abandonment of thermal engines in Europe. The aim is to safeguard the potential of technical expertise in these areas, while continuing to invest in the search for new operational energies.
336. Beyond the fighter's equipment, the physical and radio protection of equipment, vehicles, living spaces and communications will have to be adapted to these growing constraints (heat, sandstorms, cold and associated energy needs...).

Section III - The Air force

Doctrine

337. The responsiveness and flexibility of its organization give the Air and Space Force (AAE) certain skills to face the challenges of climate change. As such, the MORANE concept³⁶ allows rapid deployment with a small logistical footprint. With regard to the possible increase of the AAE's assistance to humanitarian crises, the functioning of civil-military actions (ACM) is well described in DIA_3.19-CIMIC (2019). The adaptation of the volume and resources committed will be reflected in successive operational contracts. In addition, the specificities of the actions of the AAE on the national territory will be explained in the DIA 3.60.3 employment of the air forces on the TN.

Missions

338. Climate change could affect the performance of flight operations by degrading the availability of infrastructure and equipment. Technical or infrastructure adaptation measures should be considered. For example, drought conditions, the subsequent reduction in soil water holding capacity and therefore the increased likelihood of flooding could damage airfield runways and pavements. Assessments of susceptibility to floods, droughts and ground movements must be carried out on the various bases.
339. Air operations will be constrained by the impact of climate change. Indeed, aircraft performance is related to weather conditions (pressure, temperature). With the atmospheric variability induced by climate change, air operations could be subject to new imperatives, for example, in the field of air transport with a reduction in the loads offered. Nevertheless these unusual situations have already been encountered during operations in Africa and they are not new.
340. The proliferation of insects in humid and hot areas presents risks on the operation of aircraft (clogging of aerations, probes and degradation of turbine blade performance), but also generates an increase in bird hazard.
341. Extreme weather events are expected to increase in intensity, as well as frequency, in mainland France as well as in the overseas territories and on the sites where our units are deployed. Each site will be required to have emergency release plans and plans to protect the most sensitive and exposed aircraft and equipment.³⁷
342. The Air and Space Forces could be called upon to develop their interventions, particularly in the Arctic region. Studies must be carried out to assess the specific constraints related to operations at high latitudes (impact on navigation systems, because of the very important difference between the true North and the magnetic North).
343. Studies will also be conducted to measure the consequences of opening new communication routes near the North Pole to anticipate aerospace operations and deployments in this area.
344. Similarly, air operations in Africa, the Middle East and Asia make it possible to have a significant LL on the activity of means in areas subject to high heat. Thus, the specifications of the technical constraints must consider the resistance to extreme temperatures. As such, the experience of engagement in the Sahelian or polar zones shows the importance of equipment designed to lessen or dispel the effects of temperatures.
345. Climate change has an impact on spatial observation in several ways. Sensors less sensitive to atmospheric conditions will have to be studied and developed to satisfy, in quantity and quality, institutional and military needs in space imaging. The alteration of atmospheric conditions, the disruption of the cloud formation process and the change in the density of the atmosphere affect the quality of spatial observations. It also affects terrestrial ecosystems in particular on vegetation, cloud cover, water resource distribution and therefore impacts the quality of satellite data used to observe the Earth.

³⁶ *Mise en Œuvre Réactive de l'Arme aérienne* . Reactive Implementation of Air forces

³⁷ Climate change will also have an impact on optronic sensors affecting the RAFALE , laser ammunition guidance kits...

- 346. Space launch facilities will need to be protected from rising seas as they are often built close to the coast. In addition, erratic winds in the upper or lower levels of the atmosphere could influence the launch path of satellites and missiles.
- 347. Climate change is likely to create weather constraints (temperatures, wind force near the launch pad, wind direction) stronger on the sensitivity of launchers and their implementation, on the launch schedule, on the safety of people, property and the environment, both on the ground and in flight.

Training, exercises,

- 348. Aviators are trained to operate in a wide range of environments, especially in extreme temperatures, in Africa and the Middle East. Nevertheless, the climate changes in metropolitan France will lead to adaptations in terms of organization on metropolitan air bases. For example, the adaptation of training to hot days, or the organization of training according to working hours on hot periods are imperative to take into account.
- 349. These types of interactions require adequate training of aviators operating in C2 «air» organisms, like the exercises organized overseas (example of Southern Cross in New Caledonia).
- 350. In addition, humanitarian missions are often highly publicized. They have as many benefits as they have risks. The communication teams of the AAE and the airmen in charge of the Info Ops will be trained and made aware of these issues. The actors on the front line on the media issues of such missions will therefore have to be sensitized by clear guidelines and adapted language elements.

Equipment

- 351. In high heat, the operational performance of equipment may be affected (aircraft payloads, system endurance, premature wear).
- 352. To operate in areas of extreme cold, changes must be made in terms of:
 - a. Support equipment (implementation, troubleshooting, storage) – modified according to temperature ranges encountered;
 - b. Procedures to optimize the use of resources and reduce wear;
 - c. Resize deployment batches to ensure the requested technical availability rate.

Space environment

- 353. Military and dual space capabilities as well as commercial space services can support relief operations. Positioning and synchronization services from GNSS³⁸. (including GPS and GALILEO), telecommunications and Internet access services, and earth and atmosphere observation services contribute directly to prevention, monitoring and management of natural disasters³⁹
- 354. The design of space monitoring systems and sensors, as well as ground antennas for data links with satellites, should include wider operating ranges, particularly in temperature, as well as increased weather protection. Hardware redundancy and maintenance optimization will have to improve the resilience of the equipment.
- 355. The connectivity between satellites (by laser-type optical link) and the integration of embedded intelligence in the space segment will also improve the autonomy, resilience and responsiveness of military space capabilities, overcoming the dependence on terrestrial antenna networks.

³⁸ Global Navigation Satellite System

³⁹ Satellite communications ensure continuity of the chain of command and control in an environment where communications networks are non-existent, unusable or destroyed. GHOM's satellite-based remote sensing products provide decision support to optimize rescue operations. Internet of Things (IoT) based services make it easier to track and conduct rescue operations: location and satellite tracking of goods and people equipped with ad hoc beacons, in addition to GPS and GALILEO services.

Section IV - The service of the Commissariat for armed forces

Doctrine

356. At the strategic level, the central directorate of the service of the *Commissariat des Armées* (DCSCA) will define a climate risk adaptation policy. It will then be translated into technical guidelines by its joint support centres, in particular the joint support centre in charge of combat equipment (CIEC).
357. The CIEC – SCA⁴⁰'s research laboratory – equips soldiers in their daily lives and for their missions, in all theatres. It will have an important role to play in innovation, the development of ideas and research into the latest generation of fighter equipment. The CIEC will see the rise of a technological monitoring system open to civil society partners (dual innovations) and allied nations to create synergies in research and development that benefit all.
358. It will have to constantly reconcile the incremental progress of data sciences (artificial intelligence, quantum computing) in future equipment (sensory sensors integrated into the lattices, equipment of life in autonomous campaign) with the vulnerability of digital technology in contact with an abrasive environment. Significant industrial and/or state investment will be essential to take account of the surge in factor costs.
359. At the central and local level, Business Continuity Plans (BCPs) will be updated periodically considering the climate threat to strengthen the operational and organic resilience of the SCA.

Missions

360. The SCA, through its mission of providing food services and delivering finished products in operations and on the national territory, must take more account of food preservation in hot zones. Operational supplies will have to adapt to withstand extreme temperature ranges. The question of food sources will arise, and a special effort will be made on the conditioning of combat rations (thermal insulation) to preserve or even strengthen their shelf life.
361. Water supply and storage are preeminent topics for the SCA given the overall rise in temperatures and periods of water stress.

Training, exercises

362. The SCA will integrate climate into its training and training cycles, deciding:
 - a. To participate more in extreme climate exercises (hot/cold) to test the latest generation of life equipment in the countryside. For example, the *Brilliant Jump / Cold Response* exercise in Norway was an opportunity to deliver the cold pack complement to participating units;
 - b. To refine the ambition to organize and develop its own exercises and trainings, to improve the collective operational preparation of the service;
 - c. To include a climate hardiness training module in the individual operational preparation of SCA military personnel. With the aim of acclimatization, the projected personnel will first carry out all or part of their operational preparation in an environment that is as close as possible to that encountered in the most demanding theatres of operation.

Equipment

363. The SCA is primarily concerned as the departmental operator of the fighter's clothing and equipment function. To meet the challenges of operational support by 2050, the SCA will initiate a major transformation covering the organizational, capacity and cultural fields.
364. To allow the fighter to evolve in good conditions in all weather and in all circumstances, measures in terms of equipment were taken by the SCA such as the purchase of air conditioners of tents or

⁴⁰ Service du commissariat des armées (SCA) : support service in charge of clothing, food...

sunshade nets. In desert areas, the generalization of breathing effects is already a reality⁴¹. SCA will have to go further by capitalizing on solar energy. He developed and diffused the F3 combat suit, lighter and more breathable than the current T4 S2.

365. For missions in cold areas, the individual pack will be provided and generalized to all deployed units (insulated mittens with a removable opening on the index finger to allow shooting, or shoes with integrated hot water). It will be supplemented by adapted camping capacities (igloo tent, pellet tent) offering body protection. Negative temperatures have an impact on energy storage (battery). Innovation efforts related to industry, engineering, Infrastructure and energy support services are therefore necessary to improve the energy storage of batteries.
366. In parallel, the SCA provides containers (the acquisition of flexible containers) for the storage of water for human consumption. The SCA will develop, in conjunction with the relevant departments of the Ministry (SSA, Procurement Agency, Innovation Agency, etc.), prototypes incorporated into the combat suit ranging from the atmospheric water generator to the urine and perspiration recycling kit. These miniaturized systems must allow to have a daily autonomy in water of human consumption while reducing the weight of the fighter.
367. Collectively, the increase in moisture masses in the atmosphere (because of rising temperatures) and the resulting torrential precipitation must be exploited. Air capacitors and rainwater retention/filtration tanks will eventually (2040-2050) equip the entire field equipment consuming water in its operation⁴².
368. In the face of climate changes with slow or fast kinematics, other measures are being studied and will have to be adapted on a large scale to allow the fighter to evolve in the right conditions:
 - a. The acquisition of hot air "cannons" for the cold climate;
 - b. Innervated by solar collectors, the combat gear will be optimized to power the batteries (transmissions, small-caliber weapon, etc.) and reduce the soldier's body temperature by perfecting thermoelectric or evaporative cooling techniques;⁴³
 - c. In terms of camouflage, the «chameleon grid» with energy sensors (solar in particular) will replace the F3 BME grid by 2040-2050. It will be able to reproduce in real time and with a high degree of detail (low pixelation reflection) the immediate environment of the fighter;
 - d. Complete staffing of forces with lighter and more "breathable" combat gear;
 - e. Develop an igloo tent, a pellet tent (heated by a pellet stove) and optimize reversible tents (hot/cold), and boudin tents;
 - f. Develop studies on fibre, thermo-breathable and lightweight equipment;
 - g. Develop the heat nets.

Section V - The Military Health Service (SSA)

Doctrine

369. The Military Health Service as the Ministry of Armed Forces Health Operator is a comprehensive service integrating medical support from levels 1 to 4, research, training, supplying and early warning. As such, monitoring is ensured regarding the impact of climate change on health. The integration of all components of the service makes it possible to consider information from monitoring, research and feedback. Where necessary, the care, organization and advice practices at the command are adjusted by the Directorate of Training, Research and Innovation (DFRI).

⁴¹ F3 combat suit with multi-environment bariolage (BME), thermo-breathable underwear.

⁴² Laundry, kitchen, shower and field sanitary.

⁴³ Peltier effect, by which an electric current is converted into a temperature difference.

Missions

370. The Centre for Epidemiology and Public Health of the Armed Forces (CESPA) monitors the incidence of certain infectious diseases in the Armed Forces and monitors the evolution of infectious diseases of interest. The same applies to the surveillance of pathologies related to extreme environments or specific employment of the military (by example heat strokes during exercise).
371. The Institute for Biomedical Research of the Armed Forces (IRBA) carries out expertise, research and training in specific areas of interest such as risk prevention and protection for the benefit of the combatant and defence. In particular, it has a unit «physiology of exercise and activities in extreme conditions» which works on hot (ex: PENTHERE study) and cold (ex: Life project study).
372. Biomedical defence research is framed by the Research and Innovation Orientation Plan (PORI). It aims to improve the consideration of health constraints related to military employment environments. It also improves the fight against infectious diseases that can impair the operational capability of the forces. These pathologies expose soldiers in operation or during their preparation. Finally, PORI identifies as a priority the infections causing diarrhoea, low acute respiratory infections and tuberculosis, transmitted by arthropod vectors and caused by class 4 and threat agents.
373. Research should aim to improve prevention, vector control, diagnosis, treatment and knowledge of the causes of unexplained fevers (epidemiologically). The PORI allows the evaluation of the health of the military, the effectiveness and efficiency of health actions in the armed forces, the improvement of hygiene practices. It identifies methods and practices to reduce risk behaviours and increase health-promoting behaviours. In addition, it assesses the risks to military health and the maintenance of expertise in animal epidemiology.
374. Within NATO, the problem was also considered with the creation in 2023 of the «cold weather operations medical panel» (CWO MedP) belonging to the «Military Health Care Working Group» (MHC WG) dedicated to operational medical support in a «very cold» environment.
375. Within the medicine of the forces, the 7th medical centre of the armed forces (CMA) of Lyon has been designated «high cold sponsor» and develops projects of research, innovation and training about the medical support in cold environment.
376. Finally, the creation of the Military and Veteran Health Observatory (OSMV) aims to measure the exposures that military and former military personnel may have faced during their activities and the possible consequences on their health.

Training, exercises

377. Specific trainings, adapted to extreme climate environments are set up for the benefit of SSA staff. The 7th CMA trains staff to take care of the injured in cold weather.
378. The nursing staff benefits from training in infectious risks, focusing particularly on tropical infectiology and epidemiology, as well as specific physiological constraints related to extreme environments.
379. The SSA is working on the development of distance learning, simulation methods and training evaluation techniques.

Equipment

380. The medical supply component⁴⁴ is responsible for manufacturing health products, setting up and maintaining operational medical units (OMUs). It supplies SSA establishments, stores and distributes managed items. It maintains the biomedical and technical equipment in operational

⁴⁴ The component includes an Army Health Products Supply Directorate (DAPSA) and specialized institutions: Central Army Pharmacy (PCA), Army Blood Transfusion Centre (CTSA), Health Finance Procurement Platform (PFAF-S), the SSA Central Materiel Establishment (ECMSSA) and two Army Medical Supply Establishments (ERSA).

condition. The components of these stocks are necessary for the missions of the SSA including the management of infected patients, including in case of extreme temperature.

381. The equipment is adapted under the responsibility of the Directorate of Supplies of Army Health Products (DAPSA).
382. A committed transformation of the SSA aims to provide the service with new capabilities in several segments of the medical chain. As with all military equipment, issues related to operating temperatures are taken into account. Projects are underway to adapt the caregiver's equipment (e.g., heating medical bulb box...).
383. A strategic stock policy is being developed, which considers the adaptations related to the impact of climate change on the use of forces. In addition, funding requirements have been expressed under the upcoming Military Programming Act to strengthen production capacity and modernize Army Medical Supply Facilities (ERSA).

Section VI - Joint Munitions Service (SIMu)

Missions

384. Climate change can have significant impacts on munitions and their storage. To mitigate these risks, adaptation measures such as the construction of more weather-resistant facilities and risk management protocols are needed to ensure the safety of ammunition and personnel.
385. Rising temperatures combined with drought are leading to increasingly large forest fires. This parameter is to be taken into account on the national territory and outside the national territory for the storage of ammunition. The SIMu has set up second response team members (ESI) at certain sites to intervene as quickly as possible. In the future, for depots located in wooded areas, site clearing and tree pruning near pyrotechnic sites will have to be ensured.

Equipment

386. The increase of extreme temperatures, windy phenomena, forest fires (in the south as in the north of the continental France) and thunderstorms (lightning and rainfall) could have a growing impact on the storage of IMO ammunition and *de facto* on the Joint Staff's ammunition support function.
387. To prevent these phenomena, the SIMu has:
 - a. About twenty temperature-controlled containers for storage in oversea deployment only;
 - b. "Heat protection" nets to be placed on "conventional" containers;
 - c. Hardening devices for depot stores on Reunion Island;
 - d. Lightning arrestors suitable for pyrotechnic sites;
 - e. Digital systems to measure temperature and humidity in storage stores and dryers to control humidity.
388. These solutions are not homogeneous in all SIMu facilities, both in mainland France and overseas or in operations. Some facilities need to be adapted and consolidated according to climate risk mapping.
389. It will be launched a forward thinking on storage infrastructures on the national territory or in deployment (solidity, storage conditions, location, lightning, fire safety, etc.). The regulation of

storage conditions is becoming increasingly complex with regard to environmental standards (biodiversity, post-Lubrizol⁴⁵, etc.) and pyrotechnic activities.

390. Thus, the construction of underground stores or igloo type must be generalized. It must be combined with temperature and humidity control and control systems to limit the premature wear of a munition or its operational capacity. At the same time, manufacturers will have to develop more resilient munitions.

Section VII - The Operational Energy Department (SEO)

Doctrine

391. SEO is the energy provider of mobility for the Ministry of Armed Forces. This energy consists mainly of liquid fuels for vectors and for emergency or operational power generation. It will be supplemented in the short or medium term by a panel of new and alternative energies necessary for the deployment of force (sustainable fuels, batteries, hydrogen, etc.). SEO also provides the various ingredients and products necessary for the functioning of major vectors and materials.
392. SEO is particularly concerned by energy trends and is directly impacted by developments in new energies.
393. The defence code has integrated new energies into the responsibilities of SEO, it ensures procurement, the storage and distribution of petroleum products and alternative energies necessary for the armed forces and for any service or body under the Ministry of Defence.
394. The SEO has integrated the need for expertise in alternative energies in particular at the DSEO⁴⁶ with the operational energy policy and the energy roadmap of the future addressed by the energy branch of the Joint staff. CETSEO⁴⁷ now has a low-carbon operational energy cell and BPIA has⁴⁸ an operational energy training module focused on the energy transition.
395. SEO is a recognized leader in allied energy support and actively contributes to NATO's operational energy support publications. In this capacity, he works closely with the Centre of Excellence for Energy Security (ENSEC CoE) to develop future strategies.
396. SEO continues the work related to the energy transition and its adaptation to climate change by systematizing the consideration of these issues in its organization and practices.

Missions

397. The supply and storage of petroleum products are subjects of concern, which will increase over time by constraints that will weigh on massive supplies (changes in port capacity, etc.) changes in environmental standards and CO2 emissions.
398. Climate change can also have significant impacts for the storage of fuels and ingredients for which conditions can have an impact on the quality and safety of storage (vapours, etc.) and require an increase in control actions.
399. SEO, through its mission to supply petroleum products on the national territory and in operations, must ensure the conservation of fuels and ingredients in cold, hot and/ or wet areas. For bulk products, adaptation measures such as the construction of more weather-resistant facilities will ensure product safety and quality. The preservation of the physicochemical properties of the packaged petroleum products will require a special effort on the type of packaging.
3100. The maintenance in operational condition of military equipment already integrates climatic constraints by weighting the spare parts needs for corrective maintenance according to the area of commitment. Some equipment such as hoses, flexible tanks and seals are particularly

⁴⁵ On 26 September 2019, the Lubrizol chemical products plant and warehouses of Rouen, Normandie caught fire; the plant synthesizes and stores chemical products (phosphorus and organosulfur compounds). The site is covered by the Seveso-III Directive.

⁴⁶ DSEO : Direction du service de l'énergie opérationnelle.

⁴⁷ CETSEO : Centre d'expertise technique du service de l'énergie opérationnelle

⁴⁸ BPIA : Base pétrolière interarmées

sensitive. The petroleum maintenance will have to strengthen its consideration of the climate factor.

- 3101. Rising temperatures combined with drought are leading to increasingly large forest fires. This parameter is taken into account on and outside the national territory for fuel depots and leads to strengthen preventive actions against fires in depots.
- 3102. During relief missions and humanitarian assistance in France and abroad the need for emergency energy production, the supply of fresh water and mechanical means of assistance are essential. SEO, the only State actor to have the means to support them in fuel, will be led to more frequent interventions and will have to adapt its equipment to this type of need. The operational contract and SEO resources will have to be reviewed accordingly.

Training, exercises

- 3103. SEO will integrate the climate theme into its training and training cycles, deciding:
 - a. Participate more in extreme climate exercises (hot/cold), backed up by other allied forces to test the latest generation of oil equipment;
 - b. To refine the ambition to organize and develop its own exercises and trainings on the national territory or within the framework of *joint Modular Combined Petroleum Unit* (MCPU), in order to improve the collective operational preparation of the service. To include a climate hardiness training module in the individual operational preparation of SEO military personnel. In an acclimatization objective, the projected personnel will first carry out all or part of its , in connection with the supported Armed forces; operational preparation in an environment that is as close as possible to that encountered in the most demanding theatres of operation
 - c. Adapt oil maintenance and support to work on the temperature ranges encountered.
- 3104. Extreme weather events will cause the degradation or even the unavailability of airport infrastructure necessary for the projection of military resources. In order to prepare for these scenarios, amphibious know-how will have to be better mastered and shared with the Navy and the Army.
- 3105. The impact of the arrival of new standards, new fuels (ethanol, LNG) in the capabilities of the Navy to support will be observed because the release ports are often civilian ports. Armed forces will need safe local support points per theatre.

Equipment

- 3106. To allow the fighter to evolve in good conditions in all weather, in all circumstances, capacity upgrades will be made on oil equipment to adapt to new conflict zones. In addition to improvements in personnel conditions, equipment will have to preserve transported and stored petroleum products from climatic variations.
- 3107. The increase in extreme temperatures leads to an increase in the consumption of vehicles and equipment, which will have a significant impact on the quantities of resources to be stored and on the energy to be produced.
- 3108. For missions in cold areas, the mobility of equipment will have to be adapted to these new conditions of engagement.

Chapter 4

Recommendations

401. **Recommendation 1:** Institutionalize climate security and strengthen governance within the armed forces, directorates and services. Continue its systematic consideration in the work of strategic anticipation. For this, an organic climate-defense chain, with climate-defense sponsors, must be created within each ADS central staff, with constant human resources.
402. **Recommendation 2:** Adapt the operational contracts of the Armed Forces to the increase of relief and humanitarian assistance missions in France and abroad, by strengthening our intervention capabilities to respond to requests.
403. **Recommendation 3:** Strengthen logistical capacity and support points to prevent operational resource shortages. Reflect on pre-positioning and the ability to quickly deploy the necessary equipment.
404. **Recommendation 4:** Continue research and development on human support in extreme weather conditions (equipment and protection of the fighter in hot and cold).
405. **Recommendation 5:** Strengthen the resilience and energy and water autonomy of forces on the national territory and in external operations.
406. **Recommendation 6:** Adapt infrastructure programs to new climate conditions. Establish a forward-looking mapping of climate risks that may affect the resilience of existing defence infrastructure and, on this basis, implement a long-term strategic infrastructure adaptation plan.
407. **Recommendation 7:** Introduce awareness and training modules for MOD staff on the impacts of climate change on defence.
408. **Recommendation 8:** Support and develop strategic research on climate change defence issues in doctrine centres.
409. **Recommendation 9:** Include adaptation to climate change in our research and development capabilities (defence technology projects) and innovation processes.
410. **Recommendation 10:** Strengthen the forecasting capabilities of the military meteorological and oceanographic chain in order to have revised models of climate forecasting and anticipation, on all geographical areas of interest of MOD.
411. **Recommendation no. 11:** Revise equipment support policies to make them resistant to premature wear and this from the acquisition process, in the design margins sizing compared to wear and stress models.
412. **Recommendation 12:** Integrate monitoring of the security consequences of climate change into the Intelligence Directorate's military intelligence missions.
413. **Recommendation 13:** Include regular exchanges on the consequences of climate change and adaptation in the agendas of international military relations.
414. **Recommendation no. 14:** Deepen interdepartmental cooperation, in collaboration with civil society and NGOs, to consolidate the anticipation work and our common operational preparation and coordination and exercise processes.
415. **Recommendation 15:** Develop exchanges (studies, partnerships, meetings, exercises) with the Centre of Excellence for Climate Change and Security in Montreal and within NATO.
416. **Recommendation 16:** Develop strategic and operational partnerships with partner countries accustomed to exercises in cold environments.

Appendix A

Mapping Approach to Climate Change

- A01. In the light of various scientific studies, it is now established that climate change is due to greenhouse gas (GHG) emissions in the atmosphere from human activities (agriculture, construction, industry, transport, etc.). These greenhouse gases are mainly carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O).
- A02. This increase in the concentration of GHGs in the atmosphere amplifies a natural phenomenon, the greenhouse effect. We are talking about an additional greenhouse effect. Without this greenhouse effect, the average temperature at the surface of the earth would be -18°C. An imbalance is created between the power received by the earth and the power re-emitted to space; it is the radiative forcing (measured in W/m²). Historically at equilibrium during the pre-industrial era (zero radiative forcing), radiative forcing is now 2.6 W/m².
- A03. The average surface temperature has already risen by 1.15°C since the pre-industrial era (Figure 7).

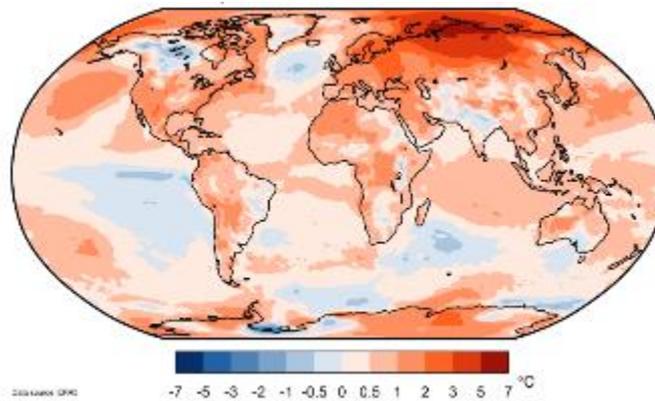


Fig. 7 - Average change in temperature at the earth's surface between 1981-2021 and 2020.

Source: Copernicus 2022.

This warming accelerated in the coming decades and the consequences on the physical and living environment will increase (Figure 8).

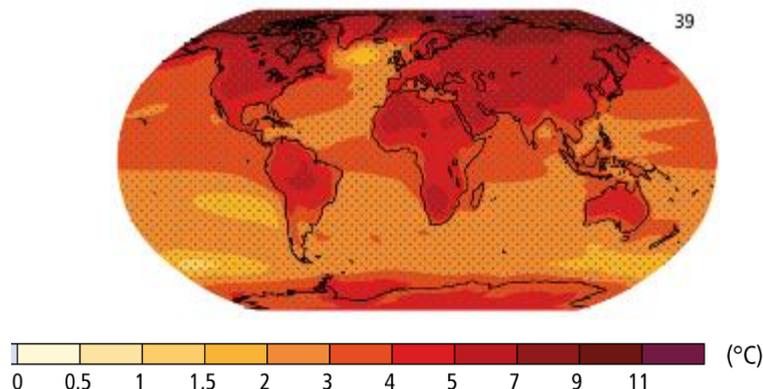


Fig. 8 - Average change in Earth surface temperature between 1986-2005 and 2081-2100, according to IPCC scenario SSP5-8.5.

Source: IPCC.

IPCC scenarios

- A04. In its latest assessment report, the IPCC published several economic development scenarios linked to GHG emission levels. The scenarios are presented as SSP1-1.9 or SSP5-8.5. The first number corresponds to an economic development scenario including population, education, urbanization and GDP. These scenarios, ordered from 1 to 5, range from the most optimistic to the most pessimistic from a climatic point of view. The second number corresponds to the radiative forcing (in W/m^2) associated with this scenario. It is between 1.9 and $8.5 W/m^2$.
- A05. Each scenario is associated with an emission quantity. Figure 9 presents the five IPCC scenarios, indicating the associated annual CO₂ emissions over time.

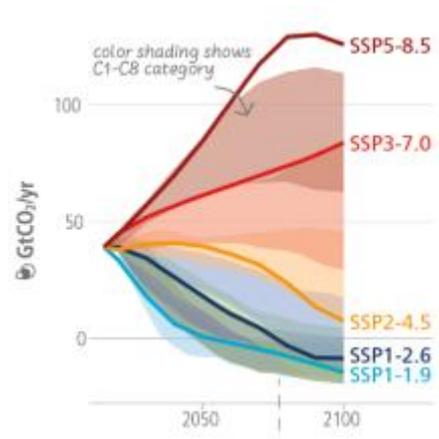


Fig. 9 - CO₂ emissions per year (in GtCO₂/year) depending on years and scenarios.

Source: Synthesis of the 6th IPCC Assessment Report, 2023.

The tipping points

- A06. Using current climate data, climate models and scenarios, the IPCC describes the impacts of climate change on the physical and living environment over the coming decades. The «tipping points» are thresholds from which we move to a major change in the climate system, possibly irreversible. Several potential tipping points have been identified by the scientific community, the main ones being the melting of the Antarctic and Greenland ice sheets, the melting of permafrost, the end of the North Atlantic thermohaline circulation and the transformation of the Amazon rainforest into savannah. They will be presented in more detail in the following sections.
- A07. It is difficult for scientists to determine with certainty the threshold that could trigger these tipping points.

Partie I - An overall increase in temperatures

- A08. Depending on the scenarios proposed by the IPCC, the amount of GHG emitted is not the same and the radiative forcing is not the same intensity. A positive radiative forcing corresponds to heat absorption by the Earth system. This resulting energy is absorbed by the oceans (91%), soil (5%), ice (3%) and atmosphere (1%).
- A09. Warming results from the absorption of this additional heat. The intensity of this warming depends on the scenario and the time horizon. It corresponds to an average increase in temperature at the terrestrial and maritime surface of the planet (measured in degrees).
- A010. Figure 10 shows the evolution of the average temperature measured at the surface of the globe, according to the IPCC scenarios and the time horizon.

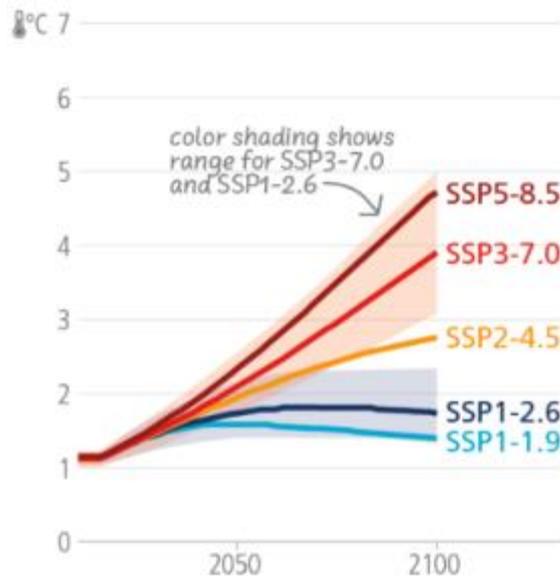


Fig. 10 - Evolution of the average temperature at the surface of the earth according to the scenarios and the time horizon.

Source: Synthesis of the 6th IPCC Assessment Report, 2023.

A011. The following graphs show the temperature variation of the hottest day, depending on the average warming. Thus, in addition to an average increase in temperature on the surface of the globe, temperature extremes will be greater. For example, in a +3°C world, the maximum temperature reached during heat waves increases by 7°C. The following figure (Figure 11) represents this phenomenon of spatial variation and amplitude variation.

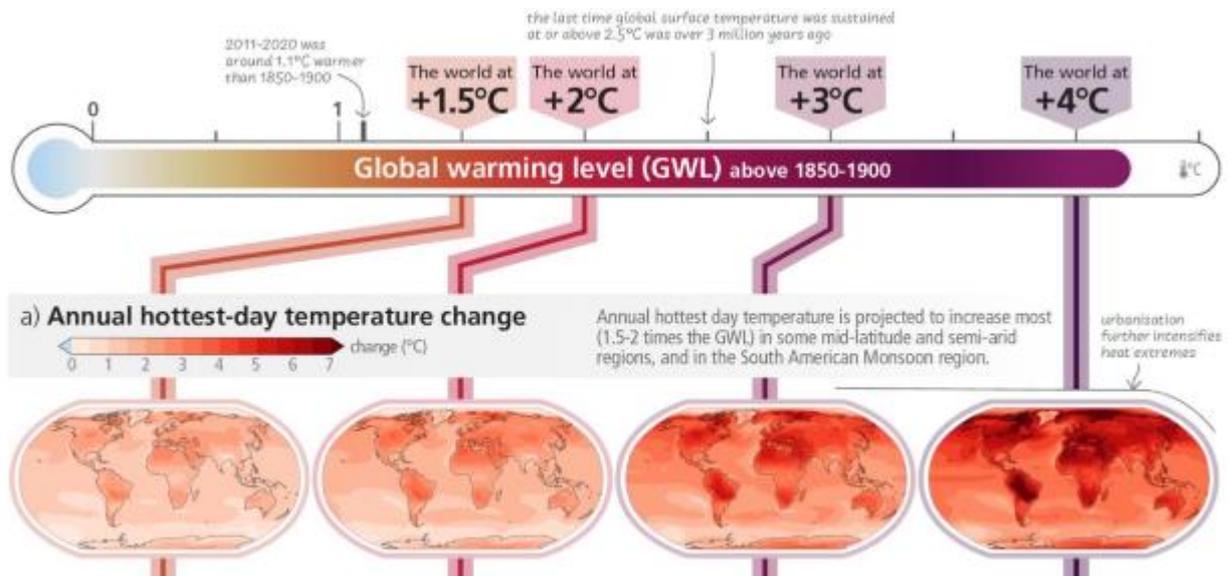


Fig. 11 - Variation of the temperature of the hottest day, according to the degree of average warming of the earth.

Source: Synthesis of the 6th IPCC Assessment Report, 2023.

Partie II - The melting of the cryosphere

- A012. Some of the additional energy received by the earth is absorbed by the cryosphere. The cryosphere initially consists of frozen or permafrost soils, which are mainly located in Greenland, the Tibetan Plateau, northern Canada, Russia and Scandinavia. Continental glaciers are part of the cryosphere (Himalayas, Andes, Alps). There are also pack ice (Arctic and Antarctic) and continental ice sheets (Greenland and Antarctica).
- A013. The average volume of these ice masses decreases. Their melting is subject to strong seasonal variations. Figure 12 shows the change in Arctic sea ice area, in millions of km² over the 12 months of the year, at different times.

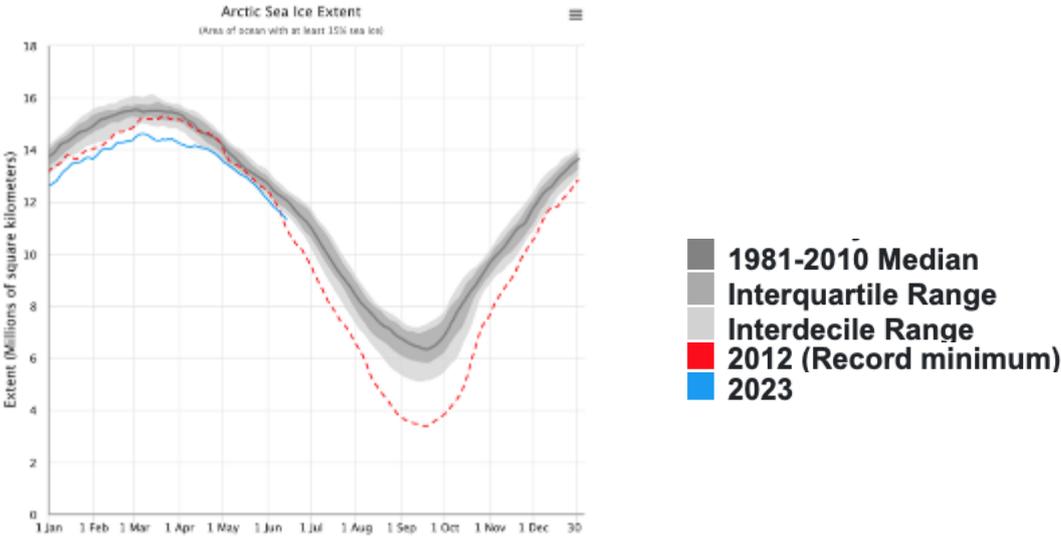


Fig. 12 - Arctic Sea Ice Surface Change (million km²).
 Source: National Snow & Ice Data Center, 2023

- A014. Figure 13 shows these variations geographically. The variation in intra-annual area is very significant. In addition, there is a decrease in the average annual area.



A015.

Fig. 13 - Geographical variations in the extent of Arctic sea ice between 1981-2010 and 2019, for September and March. Source: Météo France, 2020.

- A016. Permafrost responds to the same mechanism: a seasonal variation to which is added an overall melting trend linked to climate change. Melting permafrost releases methane trapped in ice, a GHG 28 times warmer than CO₂. This feedback loop amplifies climate change.
- A017. Similarly, global warming is accelerating the melting of continental glaciers and ice caps (mainly Antarctica and Greenland). The average rate of continental ice melt is accelerating. This change is considered irreversible on a human time scale. It is possible to determine the amount of water resulting from melting ice caps. Figure 14 shows the volume of water in the Greenland and Antarctic ice sheet that may melt, depending on the time horizon and the warming scenario. The figure also shows its consequences in terms of sea level rise (see next section).

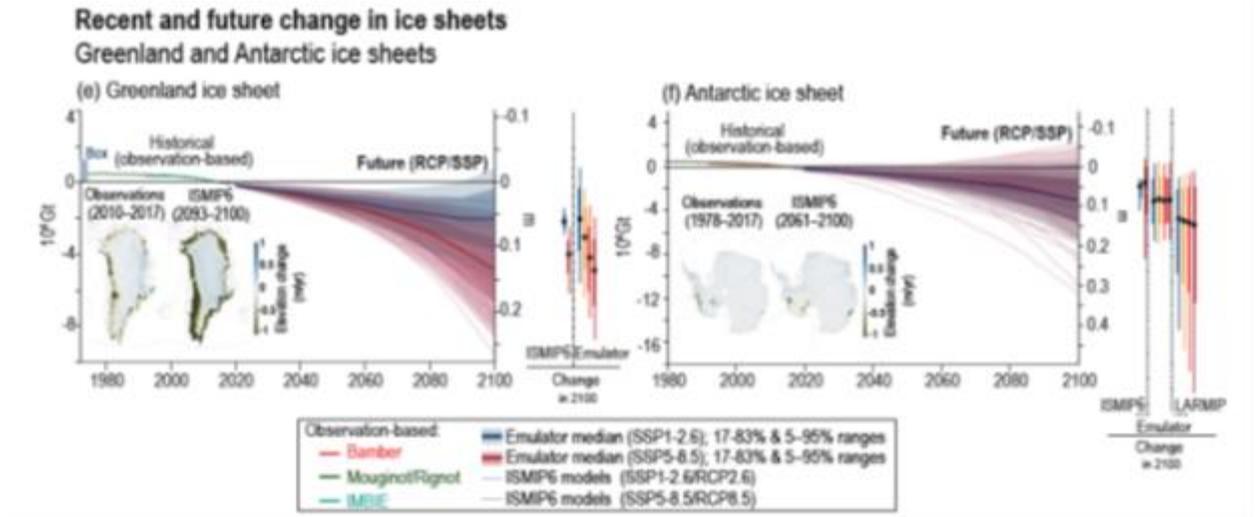


Fig. 14 - Ice volume of the Greenland and Antarctic ice sheet likely to melt depending on the scenarios and years.
 Source: IPCC Assessment Report #6, 2021.

Partie III - Consequences for the oceans: acidification and rising sea levels

- A018. Climate change is causing an average rise in the level of oceans and open seas. Two factors are behind this phenomenon:
- Melting continental ice (ice caps and glaciers) releases large volumes of water that contribute to rising ocean levels;
 - The absorption of heat by the oceans leads to an increase in temperature and expansion of the water.
- A019. Historically, these two factors have also contributed to the rise in sea levels, between the pre-industrial era and today.
- A020. Sea level is rising by an average of 4 mm/year. This increase is accelerating. Figure 15 shows the increase in sea level according to the time horizon and the chosen scenario.

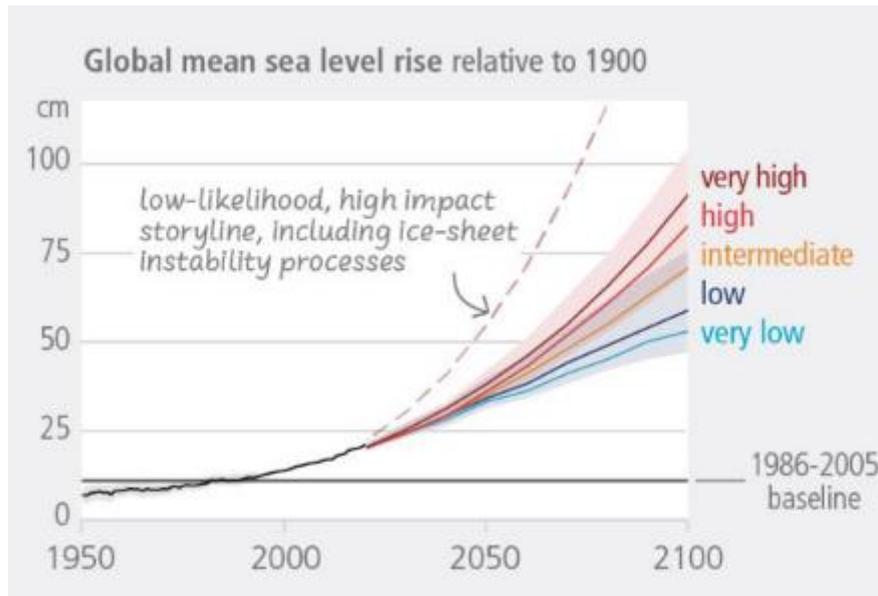


Fig. 15 - Sea level rise according to scenarios and time horizon. Source: Synthesis of the 6th IPCC Assessment Report, 2023.

A021. All the hypotheses predict an average sea level rise of at least 35 cm in 2050 (ref. 1950). However, this sea level rise is not uniform. Some regions such as Southeast Asia, the Gulf of Guinea, the Mozambique Canal are more affected than others. Figure 16 shows the geographical impact of rising sea levels.

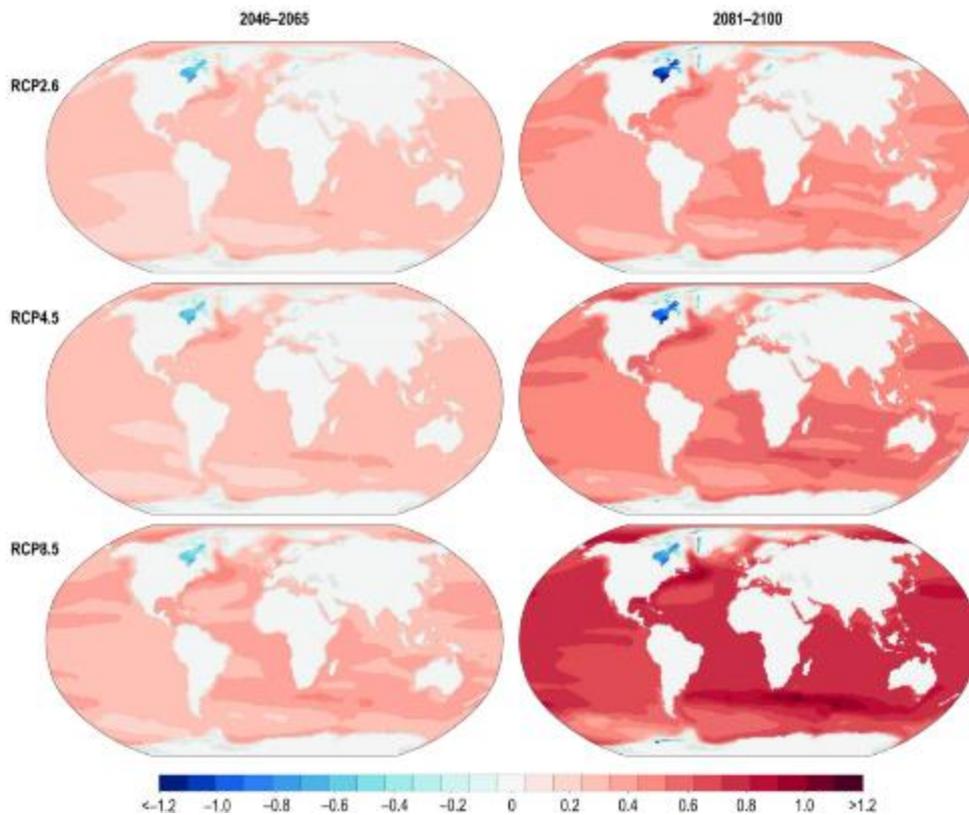


Fig. 16 - Average sea level rise according to IPCC scenario and time horizon (in metres). Source: Level Rise and Implications for Low-Lying Islands, Coasts and Communities, IPCC, 2019.

Flooding, erosion

- A022. Rising sea levels threaten coastal and island territories, as well as the ecosystems and populations that depend on them.
- A023. Low-lying coastal islands and territories are subject to erosion and are likely to disappear. In France, a study by Cerema (*Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement*) concluded that already 20% of the coastline had declined between 1950 and today⁴⁹. The coastlines of metropolitan France most affected by the withdrawal of the coastline are: Gironde, Charente-Maritime, Manche and Bouches-du-Rhône.⁵⁰
- A024. The risk of marine submersion, especially in storms with high tidal ranges, increases with rising sea levels.
- A025. Some ecosystems and the populations that depend on them will be affected. Rising sea levels cause salinization of coastal groundwater. Increased salinization of coastal areas, especially deltaic, threatens crops and access to fresh water and their ecosystems.

Acidification

- A026. Some of the CO₂ emitted is absorbed by the oceans. CO₂ reacts chemically and increases the acidity of the oceans. Figure 17 shows the evolution of ocean acidification according to the time horizon and the chosen scenario.

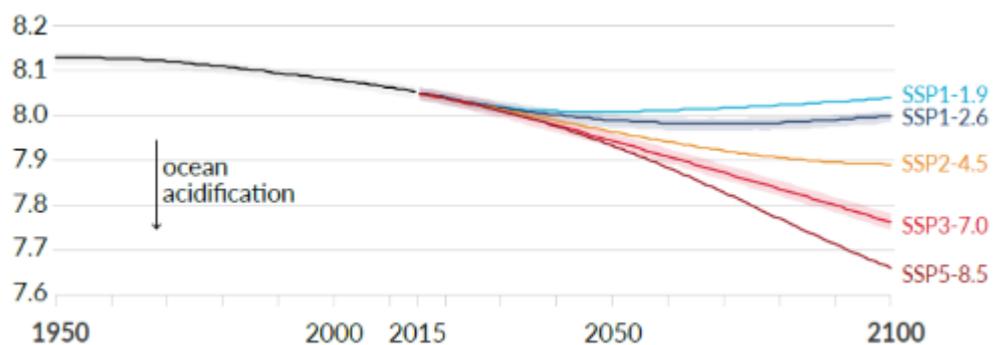


Fig. 17 - Evolution of ocean acidification as a function of time horizon and IPCC scenario. Source: 6th IPCC Assessment Report, 2021.

- A027. This acidification threatens marine ecosystems, unsuited to acidic environments. For example, it limits the ability of some organisms to form shells, which affects the ability of marine ecosystems to fix carbon.
- A028. Coral reefs, home to a quarter of marine biodiversity, are threatened with bleaching and total disappearance in the event of global warming of +2°C.

Partie IV - Extreme weather events (cyclones, floods, drought, fires)

- A029. Climate change amplifies certain weather phenomena. The frequency of these events does not increase systematically; however, their intensity increases sharply. A meteorological phenomenon of a given intensity and duration is characterized by a return period. This is the average period between two occurrences of an event of such intensity. Climate change shortens this period for particularly violent events. Thus, the extreme episodes will be closer in time. Similarly, the likelihood of exposure to multiple simultaneous or consecutive extreme weather events increases.

Cyclones, heat waves, drought, fires, floods

⁴⁹ <https://outil2amenagement.cerema.fr/les-zones-exposees-au-recul-du-trait-de-cote-zertc-r1468.html>

⁵⁰ <https://observatoires-littoral.developpement-durable.gouv.fr/chiffres-cles-r9.html>

- A030. Rising water temperatures increase the number and intensity of tropical cyclones. Hot water is the energy source for tropical cyclones. The sea temperature must exceed 26.5°C over a depth of at least 60 m to allow for the formation of a cyclone.
- A031. By generating a zone of depression, these cyclones cause strong winds (sometimes greater than 200km/h), significant precipitation and promote the submersion of coastal regions. For example, Burma was hit by Cyclone Nargis in 2008 with winds up to 240 km/h. More than 5,000 km² of the coastline were submerged, 450,000 homes were destroyed and 138,000 people died.
- A032. Rising soil and atmospheric temperatures increase the likelihood, intensity and duration of heat waves. Those of 2003 and 2022 caused excess mortality in Europe, particularly in France. According to the pessimistic scenario of the IPCC, by 2070, several regions of the world will face high temperatures coupled with high humidity. These conditions generate significant risks of death from hyperthermia, the most affected regions are: South and Southeast Asia, Central America, the Gulf of Guinea and the Guyanese region.
- A033. Similarly, the intensity and duration of droughts are likely to increase, due to rising temperatures and changing rainfall patterns. The consequences for access to water are sometimes dramatic. They threaten ecosystems and human activities. For example, the Panama Canal (5% of the world traffic), whose locks are operated by the freshwater lake of Gatún, is vulnerable to periods of drought. This situation prompted the canal administration to reduce maritime traffic by 25% in 2023.
- A034. Periods of drought encourage the spread of forest fires. Countries like Russia, Australia and Canada have been hit by devastating megafires that emit large amounts of GHGs and amplify climate change. Some previously little affected areas may be threatened by an increase in forest fires (the Amazon rainforest for example but also in France).
- A035. The Amazon forest is threatened to enter a spiral of self-destruction and this phenomenon will spread to all equatorial jungles including on the African continent, in the Republic of Congo in particular with its giant peatlands. It plays a leading role in its own survival because trees recycle rain by pumping it into the ground and evacuate it by evapotranspiration. This process recharges the atmosphere with moisture, which in turn causes precipitation. Deforestation reduces the potential for transpiration, which leads to a reduction in rainfall and therefore to a drier climate that no longer feeds the forest and risks transforming the region into savannah. This metamorphosis would lead to an upheaval in the water cycle and weather patterns around the world. It is estimated that this feedback could start when 20% to 40% of the forest is gone from 1970. Today, we are at 17%.
- A036. Due to changes in precipitation patterns and accelerated glacier melt, flood intensity and frequency are likely to increase. The increase in the temperature of the atmosphere and the temperature of the water strongly modifies the precipitation regimes. This is a change in average rainfall (positive and negative), but also in the intensity of precipitation events (more intense rainfall, periods without longer rainfall).
- A037. Climate change disrupts global ocean and climate circulation phenomena, such as the North Atlantic thermohaline circulation. The increase in temperature of the Arctic Ocean, combined with the decrease in salinity (due to the inflow of fresh water from melting ice caps) could significantly affect ocean circulation caused by differences in temperature and significant salinity between water bodies. This

already affects the *Gulf Stream*, the origin of the temperate climate of Western Europe. Figure 18 presents the historical and projected impacts of climate change on extreme weather events, according

Change in Indicator	Observed (since 1950)	Attributed (since 1950)	Projected at GWL (°C)		
			+1.5	+2	+4
Warm/hot extremes: Frequency or intensity	↑	✓ Main driver	↑	↑	↑
Cold extremes: Frequency or intensity	↓	✓ Main driver	↓	↓	↓
Heavy precipitation events: Frequency, intensity and/or amount	↑ Over majority of land regions with good observational coverage	✓ Main driver of the observed intensification of heavy precipitation in land regions	↑ in most land regions		↑ in most land regions
Agricultural and ecological droughts: Intensity and/or frequency	↑ In some regions	✓ In some regions	↑ in more regions compared to observed changes	↑ in more regions compared to 1.5°C of global warming	↑ in more regions compared to 2°C of global warming
Precipitation associated with tropical cyclones	↑	✓	↑ Rate +11%	↑ Rate +14%	↑ Rate +28%
Tropical cyclones: Proportion of intense cyclones	↑	✓	↑ +10%	↑ +13%	↑ +20%
Compound events: Co-occurrent heatwaves and droughts	↑ (Frequency)	✓ (Frequency)	↑ (Frequency and intensity increases with warming)		
Marine heatwaves: Intensity & frequency	↑ (since 1900)	✓ (since 2005)	↑ Strongest in tropical and Arctic Ocean		
Extreme sea levels: Frequency	↑ (since 1960)	✓	↑ (Scenario-based assessment for 21st century)		

medium confidence
 Major/high confidence
 very likely
 extremely likely
 virtually certain

to different levels of warming.

Fig. 18 - Past and future impacts of climate change on extreme weather events (heavy rainfall, heat waves, etc.) depending on the level of warming. The level of confidence in the results is also presented.
 Source: 6th IPCC Assessment Report, 2021.

A038. Figure 19 highlights geographical inequalities in terms of vulnerabilities and exposure to climate risks. The vulnerability of ecosystems and human societies varies widely across regions (Figure 19). It depends heavily on the level of development, unsustainable use of oceans and soils, level of social inequalities and quality of governance.

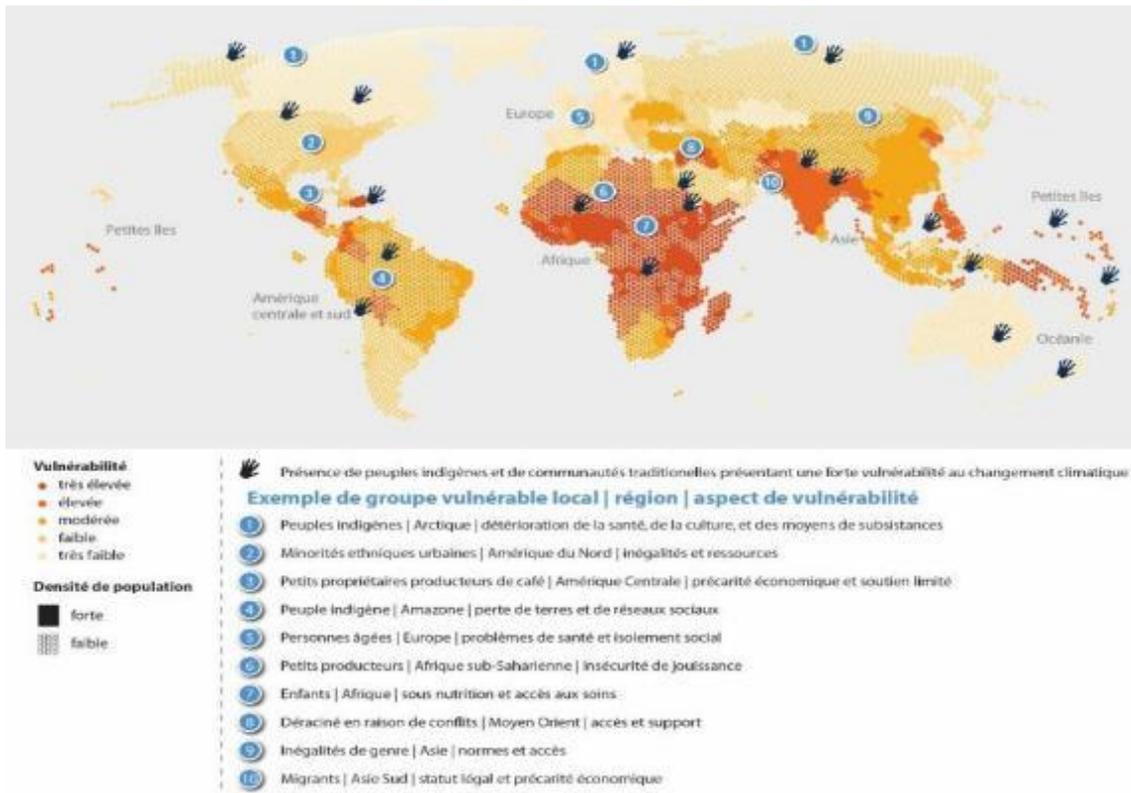
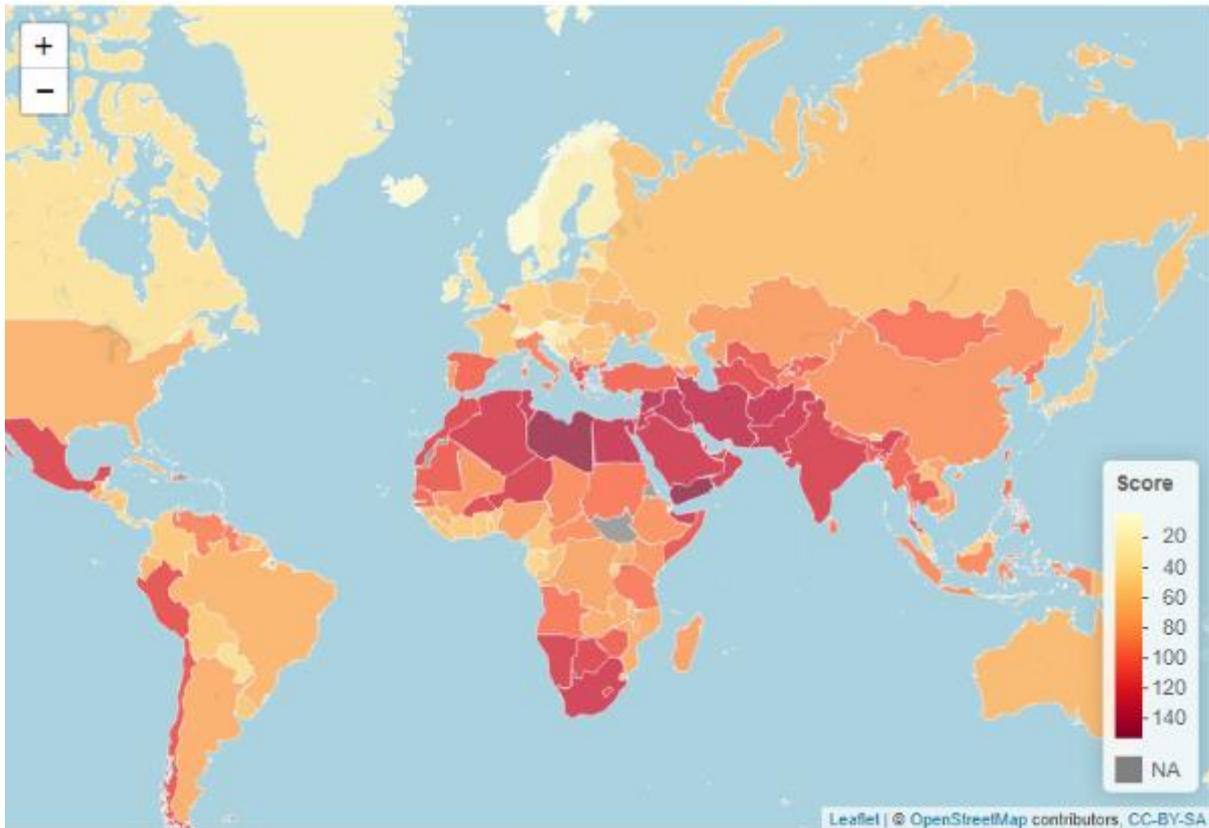


Fig. 19 - Vulnerabilities and exposures of ecosystems and populations to climate change.

Source: IPCC, 2022

Appendix B Climate Risk Mapping



Caption: combination of three indexes:

- Water stress (Aqueduct)⁵¹ of the World resource Institute
- Fund for peace ⁵²Fragility of States (FSI) *Index*
- Climate Risk (ND Gain⁵³) at Notre-Dame University

⁵¹ Aqueduct's global water risk mapping tool helps businesses, investors, governments and other users understand where and how water-related risks and opportunities appear around the world. The Atlas uses a robust, peer-reviewed methodology and the best available data to create high-resolution, customizable global water risk maps.

⁵² The Fragile States Index uses a conflict assessment framework – known as “CAST” – developed by Fund For Peace almost a quarter of a century ago to assess the vulnerability of states to collapse. The methodology uses both qualitative and quantitative indicators, relies on publicly available data and produces quantifiable results. Twelve conflict risk indicators are used to measure a state's situation at a given time. Indicators provide a snapshot in time that can be measured against other snapshots in a time series to determine whether conditions are improving or deteriorating.

⁵³ Climate vulnerability and adaptation preparedness are based on compiled indicators. Thirty-six indicators contribute to ND-GAIN vulnerability measurement and nine indicators contribute to readiness measurement. An explanation of each indicator and their data sources can be found on the Indicators page.

Appendix C

Toolkit for Deepening the Impacts of Climate Change

NAME	INSTITUTION	Indicators produced
Air quality	UNEP	Interactive map for air quality and both of drill bit
AQUASTAT	FAO	Interactive map for the risks of coastal floods, floods, droughts, landslides, tropical storms.
<i>Climate Tipping Points</i>	<i>Climate Tipping Points Info</i>	articles on climate and environmental tipping points, often accompanied by infographics
<i>Coastal Risk Screening Tool</i>	<i>Coastal Climate Central</i>	User-configurable interactive map, projection of sea level rise to 2050
<i>Global Climate Change: Vital signs of the plane</i>	NASA	Animated maps and graphs showing the evolution of global temperature and seas, ice in the Arctic, CO2 concentration in the air and methane, ice caps and rising temperatures
Global Environment Monitoring	UNEP	Environmental resources and data: air, water, pollution, mountains, oceans, biodiversity, ozone layer
<i>Global Forest Watch</i>	<i>World Resources Institute</i>	Forest monitoring: deforestation, fires
<i>Global Groundwater Information System</i>	<i>International Groundwater Resources Assessment Center</i>	Aquifer, Sampling and Drilling Databases
<i>IEA Data and Statistics</i>	AEI	Infographics, interactive maps on different energy-related indicators
<i>Indicators for national monitoring of sustainable development goals</i>	INSEE	Indicators for France to assess progress towards the Sustainable Development Goals
<i>Little green databook</i>	World Bank	Figures by world region on environmental indicators
<i>National Hurricane Center and Central Pacific Hurricane Cent</i>	<i>National Oceanic and Atmospheric Administration</i>	Map according to the zones of disturbance at sea Archiving of cyclones and their technical data sheet per year
<i>Our World in Data</i>	<i>Our World in Data</i>	Figures and infographics on air and climate, water, energy, pollution and waste[End of translation]
Rapport spécial du GIEC sur la désertification et la dégradation des terres (2019)	GIEC	infographies et cartes sur la désertification, la dégradation des sols, les écosystèmes terrestres
SDG 6 Data Portal	<i>UN Water - UNESCO World Water Assessment Programme (WWAP)</i>	Carte interactive et animée autour de l'eau, de l'économie, de la société et de l'environnement
<i>SDG Indicators Database</i>	Nations Unies	Statistiques mondiales pour évaluer les avancées par rapport aux objectifs de développement durable
<i>Water Risk Atlas</i>	Aqueduct	Carte interactive paramétrable montrant les risques liés à l'eau (stress hydrique, risque d'inondations, qualité de l'eau)
<i>WGI Interactive Atlas: Regional synthesis</i>	GIEC	Carte interactive traitant 5 thèmes principaux : température, humidité, vent, neige et glace, les côtes
<i>World development indicators</i>	Banque Mondiale	Statistiques pour les indicateurs de développement
<i>World Food and Agriculture Statistical Yearbook 2022</i>	FAO	Statistiques pour l'année 2021

Annexe D Bibliography

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- D02. ETIA-3.0.5_CCLIM(2021) - Changements climatiques et enjeux pour les forces armées françaises.
- D03. Session nationale « Politique de Défense » 2019-2020 de l'IHEDN et plus particulièrement le rapport du sous-groupe 1 (Al Ahabbi Saoud, Chailland Alain, Cordie1-Lallouet Nicolas, Dosse Stéphane, Gob Magalie, Poletti Bérangère, Smits Florence), Anticiper et prévenir les dimensions sécuritaires du changement climatique. Proposer une carte du monde présentant les pays pour lesquels les incidences sécuritaires du changement climatiques sont les plus fortes. Parmi ceux-ci, pouvez-vous identifier les zones stratégiques pour la France ?, IHEDN, Session nationale 2019-2020 Politique de Défense, Comité 6, Sous-Groupe 1, mai 2020, 18 p.
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Summary

RPIA-2024/001_CLIMAT/FORCES(2024)

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