OBSERVATOIRE Défense & Climat

Note

GEOPOLITICAL AND SECURITY IMPLICATIONS OF CLIMATE VULNERABILITY IN THE CARIBBEAN ISLANDS

October 2022

DGRIS
Direction générale des relations internationales et de la stratégie
MINISTÈRE DES ARMÉES

IRIS
INSTITUT DE RELATIONS INTERNATIONALES ET STRATÉGIQUES

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TABLE DES MATIÈRES

This brief addresses the **current and future consequences of climate changes in the insular Caribbean, as well as their geopolitical and security implications.** In this perspective, we focus our analysis on the **Caribbean arc**, traditionally subdivided into two groups: the Greater Antilles, stretching from Cuba in the northwest to Puerto Rico; and the Lesser Antilles, from the Virgin Islands to the islands of Trinidad and Tobago, which border the Venezuelan coastline further south. The region is therefore marked by the diversity of its geographical, political and cultural sub-sets, and by its integration into the vast Latin American and Caribbean region. It also has particular geological conditions, with the North Caribbean seismicity touching also Haiti, due to the meeting of the Caribbean and North American tectonic plates, separated by the Gonave microplate. This tropical region, already exposed to extreme weather conditions, is all the more vulnerable to the effects of climate changes[1]. This prompted the United Nation General Secretary, Antonio Guterres, to say at the opening of the CARICOM (Caribbean Community and Common Market) summit in July 2022: "The Caribbean is 'ground zero' for the global climate emergency" (Schneider, 2022, 4 July).

In addition to this regional particularity, there are other characteristics specific to island territories: small surfaces, geographic isolation, high dependency towards continents, but also low diversification of economic activities, with a direct dependency on local natural resources. Despite political, economic and demographic disparities, these **shared** island characteristics **result in a common experience of climate changes**. Indeed, the insularity of these territories intensifies not only their **exposure**[2] - for example, to coastal hazards due to long coastlines, or to water hazards due to limited water stocks - but also their **climate vulnerability**[3] , notably through the dependence of island economies on tourism and agriculture. Insularity characteristics also imply limited financial and political means for mitigation and adaptation[4] efforts, which must be deployed to reduce territories' climate exposure and vulnerability, resulting in a necessary regionalization of initiatives. In this perspective, regional cooperation must deal with the socio-economic and political diversity of the islands. These **include independent states,** mostly **small island developing states (SIDS), and sub-national island jurisdictions**, that is to say non-sovereign territories of the United States, France, Netherlands as well as to the United Kingdom.

The diversity of political status within the non-sovereign territories of the region, varying according to their degree of autonomy from the country to which they are attached, is also a feature of the French territories. Indeed, while Guadeloupe and Martinique are **overseas departments and regions**[5] , Saint-Martin and Saint-Barthélemy became **overseas collectivities** in 2003, after having been integrated as communes into the overseas department of Guadeloupe[6]. This legal distinction is structuring the French presence in the area, as the **French Antilles armed forces** (*forces armées aux Antilles*, **FAA)** are located exclusively in Martinique and Guadeloupe. **Maintaining the military presence in the West Indies is a major challenge in the face of climate changes which compromise the operability of bases and equipment, as well as the health of soldiers.** The increasing climatic pressures exerted on the operational capabilities of the forces will be a determining factor

[1]Variations in the state of the climate observed since the end of the 20th century, attributed directly or indirectly to human activity, modifying the composition of the atmosphere. These variations result in the occurrence of one-off and slow-onset hazards that may have environmental as well as security implications. See glossary.
[2] Occurrence possibility of a climatic-environmental hazard in a specific geographical area and for a given period of time. See glossary.
[3] Propensity or predisposition to be negatively affected by climate changes. See glossary.
[4] Process of societal and technical adjustment to climate change in order to mitigate its adverse effects, exploit the beneficial ones, and ultimately ensure the functional integrity of socio-political systems. See glossary.
[5] Article 73 of the French Constitution.
[6] Article 74 of the French Constitution.

in the conduct of France's two historic missions in the region: **the fight against drug trafficking and the population relief and rescue.**

Apart from affecting operational capabilities of the forces, climate changes are **changing the environment** in which they operate, thus **changing demands and reasons for intervention**, as well as **making missions** which are already carried out in the area **more complex**. Climate changes are a vector for regional destabilisation and inter-state tensions. They also highlight the capacity limits of civil security forces. Thus, the population relief missions demand on the armed forces, at least on the national territory, **is a structuring axis of the French presence in the area** and should intensify over the coming decades. On a regional scale**, ecosystems and socio-economic upheavals are weakening governments and relations between states, as well as creating new opportunities for international trafficking and parastatal groups**. In the face of all these pressures, which are growing in the Caribbean, the resilience[7] of the FAA is a real issue of sovereignty. The safeguarding of this sovereignty will rely on maintaining France's role in regional balances, particularly through regional cooperation bodies, and on its ability to guarantee the protection of French populations; more specifically, **their environmental security**[8].

Therefore, **anticipating climate changes and their manifestations in the Caribbean islands is, to date, the indispensable pillar of any prospective reflection on the French presence in the zone. Similarly, the development of a specific adaptation strategy for the Caribbean, as well as regional cooperation processes around this adaptation, appears inevitable for any strategic planning exercise.** To this end, this briefing note attempts to link current and known climate developments with their ecosystems, social, economic and political implications in the Caribbean islands. The first part of our analysis specifically assesses the climate vulnerability of the Caribbean islands, both as individual entities and as a region, and how this vulnerability may affect the resilience of the French armed forces. Based on this initial analysis and supported by the collection of forecasting data, three foresight scenarios were developed. Among those, a business as usual trajectory and two disruptive trajectories were developed, highlighting situations of tension for the forces, under the combined effect of climate changes, as both a limiting factor and a source of solicitation of military capabilities. Finally, on the basis of our study of Caribbean climate vulnerability and our regional prospective work, several recommendations are formulated for the Caribbean islands based French army.

[7] Elasticity of a system withstanding a disturbance or a hazardous event. It can be reactive or proactive. See glossary.
[8] State of human security guaranteed by the proactive minimisation of anthropogenic threats and negative environmental pressures on the functional integrity of the biosphere and its human component. The main goal is to reduce the vulnerability of socio-economic systems and their populations. See glossary.

CLIMATE VULNERABILITY IN THE CARRIBEAN ISLANDS

A – CARIBBEAN ISLANDS EXPOSURE TO CLIMATE CHANGE

1. Droughts and rising air temperatures

Findings

The first manifestation of climate changes in the region is the increase in average air temperatures. In this respect, scientific projections agree that there will be an increasing number of hot days and nights in the Caribbean by the end of the century, correlated with a **marked decrease in precipitation,** particularly during the rainy season from June to November (Christensen et al., 2007). Indeed, in the Caribbean, the effects of the rise in temperature are amplified by the alternation of wet and dry seasons, with the former progressively receding in comparison with the latter. This phenomenon is even more intense in years marked by the El Niño events. Thus, the combined effect of increasing air temperatures, marine evaporation[9] and reduced rainfall is expected to induce an **intensification** as well as **an increase in droughts**[10] (Community of Latin American and Caribbean States CELAC, 2014).

Recent temperature trends are consistent with these projections. According to the World Meteorological Organization (WMO), **2020 was one of the three hottest years on record for the region**, with an increase in the number of hot days, and an average temperature anomaly of +0.8 °C compared to the average temperature for the period 1981-2010 (WMO, 2020). Moreover, although the projection of an annual decrease in rainfall has not yet been verified, specific periods of meteorological drought have multiplied in recent decades (Herrera & Ault, 2017). Of particular note, we can identify the 2009-2010 drought, during which the entire region was hit by water shortages due to a significant deficit in rainfall, particularly at the Maurice Bishop International Airport in Grenada[11](Farrell et al., 2011). Seasonal variation in weather patterns, exacerbated by climate changes, exerts an additional pressure on water resource in a region that already encompasses 7 of the 36 most **water-stressed**[12] countries in the world (Food and Agriculture & Caribbean Institute for Meteorology and Hydrology CIMH, 2016). It is partly due to the reduced territory of most of Caribbean islands and their **limited hydrological groundwater storage capacity**.

Ecosystem consequences

Fluctuating water resources are one of the most deleterious effects of climate changes on terrestrial biodiversity in the Caribbean, where rainfall is the main source of water (Gould et al., 2020). **Reduced soil moisture** also exposes plants to water stress, sometimes after only a few consecutive dry days (FAO & CIMH, 2016). During drought or high heat periods, **streams, reservoirs, lakes and ponds are weakened**, making tropical island freshwater **ecosystems**[13] **fragile** (Comité de bassin Martinique, 2015). The Caribbean wetlands

[9] Even though it sounds counterintuitive, increased marine evaporation is part of the general disruption of the water cycle that can lead to both increased air humidity and increased droughts (Wei et al., 2016).
[10] According to the Intergovernmental Panel on Climate Change (IPCC), a drought is a period of abnormally dry weather conditions long enough to cause severe hydrological imbalances (IPCC, 2018). See glossary.
[11] Between March and September 2009, the recorded rainfalls represented only 50 % of normal rainfall; between October 2009 and January 2010 it represented 19 to 37 % of normal rainfall, and, finally, in February 2010, rainfalls fell to 0.03 % of the normal average (Farrell et al., 2011).
[12] When the demand for water exceeds the quantity of water available, or when its poor quality limits its use (European Environment Agency, 1999). See glossary.
[13] Water resources can vary greatly depending on the relief of the islands. The lower the relief, the lower the capacity of the island to store rainfall, which increases the risk of water shortage.

ecosystems, among which swamps forests, marshes and grasslands, have an increased sensitivity[14] to these phenomena as they are already subject to high urban and industrial pressure, which they are constantly retreating from[15](Parc National de la Guadeloupe, 2015). Among consequences of drought, and more specifically of water stress, we can also mention the **disruption of the essential ecological role of mangroves, which protect coasts from erosion, reduce wave energy, filter coastal pollution**, and constitute the habitat and nursery of a large animal biodiversity. Mangroves also help protect the coastline from hurricanes and tsunamis.

In addition, drought **periods and water resources depletion greatly increase risks of bushfires**[16], destroying patches of dry forest or crops, natural habitats, or infrastructure, and requiring even more water to be contained. In Dominica, more fires were reported in the first quarter of 2010 than in the whole of 2009 due to the drought[17]. Grenada saw a 150 % increase in bushfires over the same period (Farrell et al., 2011).

Socio-economic consequences

Rising average air temperatures, multiplication of hot days and water resources depletion are limiting factors for human activities and can also greatly threaten population health. Barbados, for example, uses almost 100 % of its available water resources, and Saint Lucia has a water supply deficit[18] of about 35 % (IPCC, 2022). In May 2022, several media outlets reported extremely low rainfalls in Martinique, leading to a decrease in water resources which, compounded by **inefficient distribution networks**, resulted in water cuts lasting several hours in some neighbourhoods (Guilon, Y & Lorand, K., 2022, 15 May). In the region**, compromised water distribution networks can lead to tensions and even conflicts related to competition between different categories of water users** (Farrell et al., 2011). Limited or uncertain access to water is also a source of **food insecurity**[19] and **financial insecurity** in terms of basic human needs, but also in terms of its crucial role for two major economic sectors in the Caribbean islands: tourism and agriculture.

Tourism depends on visitors' appreciation of local comfort related to the pleasantness of climatic conditions, the quality of infrastructure and access to essential resources such as water[20](Dupont, 2013). **Agriculture** is **predominantly rain-fed** in the Caribbean. Decreasing rainfall has a particular impact on large-scale sugar and banana production[21]. These crops, in West Indies in particular, additionally cope with the recent rise of parasites[22] favoured by monoculture and climatic stress (Observatoire national sur les effets du réchauffement climatique ONERC, 2012). Yet, **despite the recent decline in agriculture in the face of**

[14] Degree to which an ecosystem may be altered directly or indirectly, positively or negatively, by climate change-induced hazards and variations. Sensitivity is particularly dependent on the deterioration of the ecosystem and its environment as a result of human activities. See glossary.
[15] In Martinique, fifteen species of fauna have already disappeared and more than sixty others are threatened, largely due to the destruction of natural habitats located in rainforests (IUCN French Committee, OFB & MNHN, 2020).
[16] Agricultural land is much less fire resistant than biodiversity-rich tropical grasslands (Buisson et al., 2018).
[17] Firefighters responded to 160 fires, compared to 103 in 2009 (Farrell et al., 2011).
[18] That is to say, the demand overcomes the supply.
[19] Food insecurity is a situation in which regular access to sufficient safe and nutritious food for normal growth and development and an active and healthy life is not guaranteed (FAO, 2022). See glossary
[20] Tourism in the Caribbean is indeed sensitive to the distribution and quantity of rainfall. Thus, the pressure on hydrological resources is all the greater during the dry season, which attracts the greatest number of visitors. The demand for water increases as a result of the high consumption of water by tourists. In Jamaica, for example, per capita water consumption is considered to be tenfold higher among tourists than among the local population (Impact Consultancy Services Inc., 2002).
[21] During the 2010 drought, Dominica's banana industry saw a 43% decrease in production (Farrell et al., 2011).
[22] In particular the weevil and the endophytoparasitic nematode.

tourism and service, it remains extremely important to the Caribbean islands' economies. In 2019, Haiti, Cuba and Jamaica are the most heavily affected, with 29 %, 17 % and 15 % of total national employment in the sector respectively (World Bank, 2021).

This results in acute poverty, reduced human development, and deleterious effects on health, nutrition and productivity in a region where the proportion of undernourished people in 2019 was of 16 %, representing 7 million people (FAO, 2021, pp.11-12). **Precariousness of livelihoods and public services is** also a major contributor to **crime** in the region, prompting people to engage in illegal activities to regain access to goods and services (Mowla, 2021). To date, however, little is known about the socio-economic consequences of rising temperatures and droughts, due to the lack of tangible damage outside the agricultural sector, and complex links between livelihoods and drought mortality (Below et al., 2007). Among the poorly documented consequences, we can count **risks of vector-borne diseases**, which are greatly increased by variations in temperature and rainfall, as well as by anthropogenic factors such as deforestation or uncontrolled urbanisation, which favour the circulation of malaria, chikungunya, West Nile fever, filariasis and dengue fever. The latter is expanding in the Caribbean and regularly produces **epidemics** in Martinique[23], the frequency of which is expected to increase in the **future**[24] (IPCC, 2022; Ebi et al., 2018).

Another consequence of droughts and heat waves is the **strain on energy resources, which are depleted by a drop in hydroelectric production** - a phenomenon that caused concern during the 2009-2010 drought[25] - and are often overstretched by the increased use of air conditioning. Cuba is a striking example, as it is particularly vulnerable to infrastructure dysfunction due to its socio-economic fragility[26]. An increasing electricity consumption can already be observed in summer due to overwhelming temperatures for the population. In this context, ageing and poorly maintained thermal power plants, which are also poorly supplied due to fuel shortages[27], were unable to meet the increased demand for electricity during the summer of 2022, resulting in long and multiple power cuts (Rfi, 2022, 1 August). In addition to power plants, ageing electricity grids can also represent an issue, by virtue of their fragility with respect to extreme temperatures and prolonged droughts.

2. Rising temperatures and water levels

Findings

In 2020, sea surface temperature in the Caribbean was 0.87 °C above the 1981-2010 average (WMO, 2020). **In combination with the region's humid climate, rising surface water temperatures favour the occurrence**

[23] The most recent one ran from November 2019 to February 2021, and recorded over 33,000 cases (Santé Publique France, 2021).
[24] This trend is likely to increase: periods of drought paradoxically lead to the multiplication of stagnant water reservoirs, particularly in areas where water access systems may be lacking or failing. These reservoirs provide a suitable environment for tiger mosquito breeding. In addition, drought eliminates the mosquitoes' main predators and competitors (Georgia, S., 2003).
[25] In Saint Vincent and the Grenadines, the contribution of hydropower to total electricity generation had fallen to 8.2 % in January 2010, and to 12 % in February 2010. In January 2008 and January 2009, the contribution was 17.4 % and 28.1 % respectively (FAO, 2016).
[26] Degree to which a social system can be altered directly or indirectly, positively or negatively, by climate change-induced variations. This fragility is social, political and economic and depends on multiple factors: adaptation strategies, level of development, poverty rate, social cohesion, and degrees of economic dependence on an activity, resources, institutions and states. See glossary, appendix.
[27] Notably,linked to the drop in oil deliveries from Venezuela.

of meteorological and climatic hazards such as tropical storms and hurricanes[28]. Indeed, according to the WMO, sea surface temperatures measured in 2020 could be related to the record-breaking number of 30 tropical storms that were registered in the Atlantic basin during this year's hurricane season[29]. These storms have accounted for more than 70 % of weather-related disasters in the region since 1960. In addition, the number of Category 5 hurricanes, which are the most powerful, has doubled since the 1950s (WMO, 2020).

Furthermore, **water temperature increase contributes to sea level rise through thermal expansion**. In the Caribbean, this rise was equivalent to +1.7 to +2 mm/year over the period 1950-2009 (Palanisamy et al., 2012), before intensifying and reaching **3.6 mm/year over the** period 1993-2020 (WMO, 2020). This is still quite close to global sea level rise average (3.3 mm/year). It can be deemed as moderate given the intensity of the phenomenon in other parts of the world, such as the Western Pacific, where increases of between 5 and 11 mm/year are recorded. However, on low-lying coasts, each millimetric rise results in a loss of territory of up to several dozen metres. **The extent of land loss as a result of sea level rise will depend directly on its magnitude: the scenario of a one-metre rise by the end of the century would result in the total submergence of nearly 9 % of the Caribbean islands, while a scenario of up to six metres would involve the submergence of nearly 50 % of these islands**[30] (IPCC, 2022).

Finally, **the increase in carbon dioxide (CO_2) atmospheric concentration is also responsible for ocean acidification**. Indeed, the ocean absorbed about 30 % of our emissions between the beginning of the industrial revolution and the mid-1990s, and this percentage is increasing with our emissions (Gruber et al., 2019). A series of chemical reactions ensues, resulting in a measurable decrease in carbonate ion saturation, indicative of an increase in carbonic acid concentration. In the Caribbean waters, carbonate saturation has decreased by about 3 % per decade between 2000 and 2017 (Melendez & Salisbury, 2020).

Ecosystem consequences

The combined effects of ocean waters warming and acidification exert considerable pressure on certain marine ecosystems that play a fundamental role in the resilience of island systems. Of particular interest, corals are essential natural barriers to the preservation of coastlines in the face of the multitude of meteorological and marine events to which they are subjected. These, from El Niño events to hurricanes, contribute to the retreat of the coastline and can generate major swells, which can completely submerge certain coral islands (Woodroffe, 2008). Corals are particularly affected by warmer waters, since the crossing of a critical temperature threshold, around 30 °C, causes them to expel their symbiotic algae. The absence of this algae leads to coral bleaching and, most of the time, to their death. As this threshold is exceeded more and more often, mortality peaks are getting more frequent and resilience periods shorter. In addition to warmer waters, corals are highly exposed and sensitive to threatening ocean acidification and strong anthropogenic pressures, notably increased pollution, coastal developments and excessive tourist numbers

[28] On the other hand, in 2022, the presence of vertical shear winds has reduced the occurrence of these meteorological and climatic phenomena. These shearing winds are also likely to alter the path of hurricanes (Chan et al., 2019).
[29] The conditions for the formation of a hurricane include a temperature above 26.5 °C in the first 50 metres of ocean depth, which acts as an energy reserve. The hurricane is fuelled by the thermal energy of the ocean, which is transmitted to the cold atmosphere through evaporation flows. The thermal energy then becomes kinetic and manifests itself in the form of wind (Météo France, n.d.).
[30] In addition, it should be noted that water levels will not be the same everywhere. For more precise and differentiated data on coastal hazards and risks of flooding according to territories, see interactive maps of https://www.climatecentral.org/ or https://www.wri.org/.

(Hoegh-Guldbergetal, 2014). Conversely, **changes in the chemical composition of water favour the proliferation of toxic species such as sargassum** (Resiere et al., 2018; 2020), which has increased massively since 2011[31].

Hurricanes also weaken island systems through their destructive impacts on mangroves, as it was the case in Guadeloupe during Hurricane Hugo in 1989 (Petit & Prudent, 2010). In similar ways to ocean warming and acidification**, sea level rise affects terrestrial biodiversity in low-lying islands and coastal regions through habitat flooding, coastal erosion and saline intrusion, especially in wetlands**. Coral reefs and mangroves are particularly sensitive (Hoegh-Guldberg, 2011). It should be noted, however, that so far coastal damage is much more largely attributed to the increase in storms and hurricanes than to sea level rise itself (Palanisamy et al., 2012). Nevertheless, risks associated with sea-level rise have been identified, including increased saltwater intrusion into freshwater reservoirs[32], which compromises water resources by making them toxic to ecosystems.

Socio-economic consequences

The primary consequence of these phenomena for populations is the gradual or occasional submergence of territories. In the first case, it implies a gradual reduction in available space, with the need to relocate coastal dwellings, infrastructures and activities[33]. In the second case, it induces sudden buildings destruction threatening population[34]. The issue is all the more serious as population density is extremely high on coasts: in 2016, 240 inhabitants/km² on Guadeloupean coasts and 373 inhabitants/km² on Martinique coasts (Commissariat général au développement durable, 2020). In order to face the dual challenge of sea level rise and erosion, inhabitants relocation planning has been developed on the Guadeloupean coastline of Petit-Bourg in the Bovis and Bel Air sectors of the North Basse-Terre agglomeration (Direction de l'Environnement, de l'Aménagement et du Logement DEAL de Guadeloupe, 2013)

Sea level rise affects ecosystem services, livelihoods[35], groundwater quality, coastal infrastructure functioning and regional attractiveness. Coastal areas not only host a large proportion of the population, but also support vital activities to Caribbean islands' economies, notably tourism[36]. **Similarly to international trade, this sector depends on coastal airports and seaports to connect territories to world markets and maintain them as international tourist destinations.** The Donald-Sangster International Airport in Jamaica, for example, is among the twenty airports most at risk from sea level rise by the end of the century (Yesudian et al, 2021). In addition, **almost all port facilities in the Caribbean are projected to experience flooding**

[31] These algae wash up on the coast in large numbers, causing significant damage to coastal habitats, seagrass beds and corals (van Tussenbroek et al., 2017).
[32] The Plateau water table, for example, in Guadeloupe, owes its salinity to a saline intrusion (Bureau de recherches géologiques et minières BRGM, 2011).
[33] According to the Caribbean Community Climate Change Centre (5Cs), a sea level rise of one metre by 2075 would result in economic losses to CARICOM of more than US$30 billion, plus permanent land losses (more than US$70 billion) and relocation costs of more than US$4 billion (Trotz & Lindo 2013).
[34] In 2017, Maria destroyed almost all infrastructure in Dominica, resulting in losses of up to 225 % of annual GDP (Eckstein et al., 2018).
[35] In particular, coral reef degradation and warming waters threaten livelihoods of Caribbean fishing communities, which are already among the most socio-economically fragile populations (Trotz and Lindo, 2013).
[36] A 2007 study identifies, for example, that in Barbados over 90 % of the 6,000 hotel rooms surveyed are located within one kilometre of the high-water mark and within 20 metres of sea level (Becken & Hay, 2007).

(Cashman & Nagdee, 2017)**, while coastal energy infrastructure such as refineries and nuclear power plants are also at risk. Their submergence poses significant risks of deflagration as well as air and marine pollution.** In Florida, nuclear power plants located in coastal areas (such as Turkey Point and Crystal River) could see their spent fuel storage sites flooded (Jenkins et al., 2020). Furthermore, an extreme weather event could cause significant infrastructure damage and, in most dramatic cases, could lead to a nuclear accident. Beyond infrastructures, energy distribution networks are also at risk, including submarine cables that link refineries to offshore operations, which are particularly vulnerable to sea level rise and acidification. Submarine cables are used, for example, to supply electricity to French islands, notably in the bay of Fort-de-France (France-Antilles Martinique, 2022, 4 March).

Finally, the increase in extreme weather and climate events weakens all links of the chain of economic stability of concerned territories. Any natural disaster induces a form of tourism activity shutdown. Financial efforts required to rebuild housing, infrastructure, and above all water and electricity networks, or to reconnect means of communication, are considerable. The economic impact of hurricanes Irma and Maria in the Caribbean, for example, is estimated to be between US$27 and US$48 billion (IPCC, 2022). Moreover, such infrastructures are essential for the proper functioning of the health system, as well as human resources, weakened when living and working conditions, or means of transport, are degraded. Thus, **extreme climate events are likely to lead simultaneously to an overstretch of health systems and to the paralysis of at least part of their capacity** (ONERC, 2012). It is in this sense that in 2017, Saint-Barthélemy and Saint-Martin' health systems were severely affected by Hurricane Irma (Nexon & Sénéquier, 2022).

Extreme weather events also induce population displacement, disproportionately high in the Caribbean relative to the region number of inhabitants (Cashman & Nagdee, 2017). These migrations are explained by the increased exposure of populations to hurricanes (Hauser et al., 2021). Their extent depends not only on damages caused on the territory, but also on the reactivity of political and humanitarian responses. The latter was lacking during hurricanes Irma and Maria, which caused considerable damage to infrastructures and health services. Several thousands of Puerto Ricans thus migrated to Florida and New York (IPCC, 2022).

B - VULNERABILITY OF CARIBBEAN ISLANDS TO CLIMATE CHANGES

1. Political ownership of climate changes in the insular Caribbean

What political and geopolitical stability in the insular Caribbean?

Composed of French, British, Dutch and US sub-national jurisdictions as well as independent states, Caribbean islands have a **wide variety of political statuses and regimes**, mostly inherited from the decolonisation process. To date, **all leaders are chosen by universal suffrage apart from the leader of Cuba, where the single party represses popular dissent through censorship mechanisms as well as political prisoners arrest**[37]. Political violence and clientelism also affect Jamaica, where political parties are linked to

[37] The discontent of the population was expressed in July 2021, under the economic pressure of the Covid-19 crisis and the American sanctions, through demonstrations which led to the arbitrary arrest of several hundred people (Le Monde & AFP, 2022, 1 February). Even more recently, following Hurricane Ian, Cubans were plunged into darkness, without electricity. Demonstrations against the government were again repressed (Gomez, 2022, 4 October).

gangs and sects. The Dominican Republic saw its Minister of the Environment shot dead in June 2022 whereas Puerto Rico, where the legitimacy of political institutions, already fragile in the eyes of the population, is tainted by the indictment for corruption of six of the island's 78 mayors. But first and foremost, the phenomenon particularly affects Haiti, which has suffered from decades of violence in the country, intensified by deadly gang clashes that have been growing since the assassination of President Jovenel Moïse in early July 2021. **Armed violence is also indicative of two chronic phenomena in the region: arms trafficking, on the one hand, and, on the other, drug trafficking from South America, of which the Caribbean islands are a hub.** In this respect, French territories, especially Guadeloupe, are primarily concerned[38] .

In French West Indies, there has been a decline in local population trust in public authorities and in the mainland, particularly as a result of natural and health disasters[39]. A culture of protest (Commission d'enquête de l'Assemblée Nationale, 2019) has developed since the chlordecone scandal[40] (Joly, 2010) and was again manifested during the Covid-19 pandemic in the face of the state's vaccination policy (Eynaud & Racon, 2021). This crisis, which is a symptom of resentment linked to the islands' colonial and slave-owning past, also has an energy dimension, as the population was also requiring lower taxes on petrol and gas (Cruse, 2022, January). The rise in street violence during riots that injured a *gendarme* with live ammunition (Le Monde & AFP, 2022, 21 January) led to the implementation of a curfew for security reasons (Le Point & AFP, 2021, 19 November), which further accentuated the discontent of the population. **In this context, climate changes appear to amplify existing political fragilities. Indeed, the legitimacy of public authorities is directly affected in the event of overstretched health systems, power cuts linked to infrastructure problems, or water supply failures, which have always been a source of mistrust in French West Indies** (Institut National de l'Audiovisuel, 2021, 29 November).

Although the political situation of Caribbean islands shows dysfunction and fragility, the regional geopolitical balance remains, for now, unaffected by conflicts. Two destabilising factors have nevertheless been identified. Firstly, migratory movements are a major source of tension, stemming from the differences in economic and human development within the Caribbean. This phenomenon is particularly critical regarding relations between Haiti and the Dominican Republic. The island of Hispaniola, which they share, and the important Haitians migrations contribute to a long-standing rift. A wall construction on the border between the two countries was launched in February 2022 by the Dominican Republic, as an expression of its desire to firmly control these migratory movements in the context of an upsurge in violence in Haiti, and more broadly to detach itself from the country's economic and security crisis (Le Monde & AFP, 2022, 21 February). In early 2022, the construction of the 54 km long border wall was launched, to be

[38] The Guadeloupean authorities were concerned that Guadeloupe was 'the French department with the highest density of dealing points' (Ouest-France, 05/02/2021). The archipelago is not left behind in terms of arms trafficking either, as evidenced the campaign launched by the authorities *Déposons les armes*" (Let's put down the weapons) with the aim of recovering weapons held illegally by the population (Guadeloupe.gouv, 03/01/2022).

[39] This has been seen also in other part of the Caribbeans. In the aftermath of Hurricane Irma, in St. Maarten (Netherlands), Prime Minister W. Marlin lost two no-confidence votes because of his ineffective management of the reconstruction effort. Similarly, after Hurricane Maria in Puerto Rico, former Governor R. Rosselló resigned from his post in the face of public discontent (Mowla, 2021).

[40] The first protests against the use of chlordecone occurred in 1974 led by Martinique farm workers. The strikes were repressed and are responsible for the death of two persons.

extended later by another 110 km. **Migration tensions can also be observed between Haiti and the Bahamas[41], as well as between Puerto Rico and the United States** (Celestine, 2010).

Secondly, **China's growing influence in the region is sustained by trade with Caribbean states[42], a diplomatic policy of South/South cooperation recently favoured by the pandemic[43], as well as growing investments.** These include also airports facilities, as part of the "Belt and Road Initiative", an interconnection project which, to date, includes eight states of the Caribbean islands[44] (Nedopil Wang, 2022, 5 July). **China, additionally, has a privileged political and ideological relationship with Cuba[45].** Beyond the ideological concordance of the two communist parties, Cuban and Chinese authorities cooperate militarily, particularly in the acquisition of equipment, training of personnel and intelligence (Dubesset, 2019). China's growing presence in a region historically dominated by the United States creates a competitive phenomenon which could potentially divide and weaken regional cooperation bodies[46].

Fragmented political handling of climate issues in Caribbean Island states.

Most insular Caribbean territories affirm a clear commitment of principle to climate mitigation and adaptation, by virtue of their increased climate vulnerability. Cuba, for example, has been one of the most proactive countries on the topic since the 1992 Rio Summit[47]. From this perspective, **Nationally Determined Contributions** (NDCs)[48] of the region's states under the Paris Agreement all mention efforts to be made in agriculture and land management, as well as coastal zone management, which is the adaptation focus most represented in NDCs (Crumpler et al. 2020). It is interesting to note, however, that not all climate hazards are identified in a comparable way by states. Phenomena intensified by climate changes but pre-existing to their manifestations, such as floods and storms, appear in more than 90 % of the NDCs of Caribbean Island states, while landslides and fires appear respectively in 31 % and 15 % of the NDCs. More globally, **countries identify the development of food security and water management programmes as the least advanced adaptation measures**[49] (UNFCCC & RCC St. George's, 2020). These disparities in the understanding of climate risks are linked to the lack of production and dissemination of knowledge on the issue[50](Economic Commission for Latin America and the Caribbean ECLAC, 2017, July-September).

[41] Long-standing tensions, reignited by Hurricane Dorian in 2019 (Nixon, 2019).
[42] These have increased eightfold over the period 2002-2019, while they have decreased by 25 % with the US (Constant, 2021).
[43] In 2020, China was the first country to assist Haiti with emergency medical equipment and was much more responsive than the United States.
[44] Antigua and Barbuda, Barbados, Cuba, Dominica, Dominican Republic, Grenada, Jamaica, and Trinidad and Tobago.
[45] Notably revealed during the Cuban protests of July 2021, when it intervened on telecommunications infrastructures to cut off the Internet and censor the protest movement (Lazarus & Ellis, 2021, 3 August).
[46] For example, President Trump's March 2019 meeting with his Jamaican, Dominican, Bahamian, Haitian and St Lucia counterparts was interpreted by the Prime Ministers of Antigua and Barbuda, Gaston Brown, and St Vincent and the Grenadines, Ralph Gonsalves, as a move to undermine CARICOM solidarity (Caribbean Insight, 2019).
[47] In 2017, the country was particularly noted for its plan for the Fight against Climate Change (Tarea Vida). Among the key objectives of this plan is the diversification of its electricity mix, which, according to the updated version of its Nationally Determined Contribution, should reach 24 % of renewable energy in electricity production by 2030 (UNFCCC, 2020).
[48] Nationally Determined Contributions (NDCs) are roadmaps of national efforts to which 196 parties committed with the Paris Agreement in 2015. They are designed to be updated regularly to reflect progress. They are submitted to the UN Framework Convention on Climate Change (UNFCCC) Secretariat every five years and are also made public.
[49] This lack is taken to the extreme in Haiti, whose agricultural policies completely sidestep the issue, despite the existence of a Directorate of Climate Change (DCC), within the Ministry of the Environment (MDE). See for example the 2010-2025 agricultural strategy, which makes no mention of the subject.
[50] In 2018, only Cuba produced more than half of the data needed to monitor sustainable development indicators. Only two additional states, the British Virgin Islands - which moreover is an unincorporated and organized territory of the United States - and Jamaica were reported to have the capacity to do so (McKenzie, Abdulkadri, 2018).

In addition to the particularities related to the understanding of risks and the specific commitments of States, mitigation and adaptation dynamics are confronted with **major institutional obstacles**. First and foremost, we can count the low political effectiveness of States, amplified by the lack of national institutions[51] specifically dedicated to the appropriation of climate issues. The **fragmentation of climate governance into different institutions** also weakens decision-making processes and the effectiveness of actions (ECLAC, 2017, July-September)[52]. This delay in institutionalisation is correlated to a lack of communication between the various institutions involved in climate issues[53]. The fragmentation of competences and responsibilities observed within sovereign islands is even more amplified within sub-national island jurisdictions. French Caribbean islands, in particular, struggle to articulate inter-municipal, regional, departmental, national and European policies (Daniel, 2019). Between these different political levels, centralised and top-down decision-making by national governments remains predominant. This tends to erase particularities of the overseas territories in favour of a metropolitan policy and compromises the development of action plans tailored for vulnerabilities of overseas territories (Ferdinand, 2018). In sum, climate changes represent a **political, social and economic challenge whose complexity requires comprehensive and rigorous governance** by states and jurisdictions, specifically exhibiting low government effectiveness (Scobie, 2016).

Regional cooperation with limited effectiveness

In view of the small demographic and political weight of islands of the insular Caribbean, the establishment of regional cooperation on climate changes quickly became necessary in order to bring their voice to the attention of major international powers, which are also the main current and historical emitters of greenhouse gases (Klöck, 2020). **This need for local unity and cohesion in face of the international community resulted in a rapid diplomatic take-up of climate changes.** As an example, we can notify a first conference on health effects of climate changes in the Caribbean in 2002 in Barbados followed by the creation of the Caribbean Community Climate Change Centre[54](5C) within the CARICOM in 2004 (Pan American Health Organization PAHO, 2019). The CARICOM offers an extensive network of agencies involved in climate-related issues such as the Caribbean Public Health Agency (CARPHA), the Caribbean Agricultural Research and Development Institute (CARDI), the Caribbean Food and Nutrition Institute (CFNI) and the Association of Caribbean States (ACS).

Regional climate-related cooperation is also structured around several organisations and at different levels, such as the Organisation of Eastern Caribbean States (OECS), a region-wide intergovernmental organisation**. Integration into this complex regional fabric is therefore a challenge for understaffed and under-resourced national institutions. They must not only adapt and coordinate national policies to the different standards and ambitions of these regional organisations, but also have to meet the requirements of two international**

[51] Or their fragility: the departments or directorates dedicated to climate policy in the region have a staff of between 2 and 5 people. This lack of staffing is representative of the limited reach of these departments, which struggle to engage in collaborations beyond simple brainstorming workshops (Scobie, 2016).
[52] In Trinidad and Tobago, for example, mangrove management is fragmented and distributed to a multitude of ministerial divisions and actors, which is a major source of indecision and dilution of competencies. (Daniel, 2019).
[53] Indeed, by 2021, neither Barbados, the British Virgin Islands, Jamaica nor Trinidad and Tobago had yet developed agreements between their respective Ministries of Health and Ministries of Agriculture or Environment on health and climate change policies (WHO, 2021).
[54] Regional entity accredited by the United Nations Framework Convention on Climate Change (UNFCCC) Green Climate Fund. Its missions are to provide data on climate changes in the Caribbean, to finance regional or national projects, to train and coach Caribbean actors, and to act as an intermediary for setting up projects with both private and public partners.

institutions, heavily involved in the region: the IPCC and the Alliance of Small Island Development States (AOSIS). The AOSIS is an intergovernmental and international organisation with the vocation to represent its members in global processes, with the aim of supporting GHG emission reduction targets and obtaining compensatory funding. **Within this regional and international architecture, the role of the 5C is prominent as the main framework for climate initiatives in the region**, working on monitoring projects[55] and information sharing[56].

However, the emphasis on risk monitoring and anticipation systems as well as on information sharing is indicative of three structural problems of regional cooperation: on the one hand, the lack of data on climate changes (Petzold & Magnan, 2019); on the other hand, the reluctance of actors to exchange the information they have (Scobie, 2016); and finally, the more general inability of various actors in the region to cooperate, as they tend to duplicate efforts without any real knowledge of actions carried out by others. In addition to the lack of resources and political efficiency, this phenomenon can be explained more broadly by the political and financial fragmentation of the region, a major obstacle to joint action, especially considering that not all islands are sovereign. Indeed, regional cooperation is further constrained and complicated by the large number of sub-national jurisdictions of non-Caribbean states (Petzold & Magnan 2019).

The case of the French overseas territories: between national belonging and regional cohesion

From the 8th to the 10th of May 2015, the President of the French Republic, François Hollande, chaired the **Caribbean Climate Summit** in Martinique as part of the preparations for the Paris conference of United Nations Framework Convention on Climate Change (UNFCCC). At this summit, which brought together 30 representatives of Caribbean states, including Haiti and Dominica. He invited the international community to consider the particularities of the Caribbean situation in the face of climate changes through the "Declaration of Fort-de-France". By stating that **"France is a Caribbean country"**, he expressed the wish that French local authorities could integrate more effectively regional cooperation. Paradoxically, he also underlines the obliteration of French Caribbean territories behind the entity "France". **The integration of French territories into regional cooperation is complicated by their status as sub-national jurisdictions.** Martinique and Guadeloupe are still not members of CARICOM, the main pillar of regional climate cooperation *via* the 5C. However, they have been members of the Association of Caribbean States since 2014, and the Organisation of Eastern Caribbean States since 2015 and 2019 respectively. Their membership of the OECS allows them, among other things, to obtain observer status at the United Nations Conference of the Parties of UNFCC. Unlike their regional counterparts such as Saint Lucia, Dominica and Haiti, overseas territories are not parties to the UNFCCC, where they are officially represented by France. However, French jurisdictions, surrounded by Small Island Developing States, are experiencing a shift from political belonging to regional cohesion based on climate vulnerability.

[55] Land monitoring (PREST project), meteorological (RADAR project) or coastal risk (CARIB-COAST project).
[56] See in particular the Clearing House information exchange platform.

French West Indies share the same exposure to climate changes as Caribbean states, which may lead them to make claims in the name of the principle of *Common but differentiated responsibilities* (CBDR). Overseas collectivities of Saint-Martin and Saint-Barthélemy are all the less able to make themselves heard on climate issue as they were one of the districts of Guadeloupe until 2007. They have no seat at the United Nations, and do not participate in any regional organisation, except *through* the representation of France - which is an associate member of the ACS (Association of Caribbean States), for example.

2. Mitigation and adaptation dynamics hampered by financial fragility

Fragile economies marked by environmental vulnerability

Although the Caribbean has disproportionately wealthy islands such as the Cayman Islands, known as one of the world's largest offshore financial centres, and islands with thriving tourist economies such as the US Virgin Islands and the Bahamas, the region is characterised by a high number of states with low GDP per capita[57]. **The region is home to fifteen Small Island Developing States (SIDS), affected by the economic recession and exploding debt levels following the 2008 crisis and, more recently, the Covid-19 pandemic.** Among them is Haiti, the poorest state in Latin America and the Caribbean, with more than 50 % of the population living below the poverty line[58](World Bank, 2022). Cuba has seen its GDP fall by 11 % in 2020, due to US sanctions and the absence of tourists during the pandemic. Economic difficulties also affect jurisdictions such as Puerto Rico, which was declared bankrupt in 2017 with a poverty rate of 45 %[59]. Indeed, **tourism and banking services make Caribbean economies highly dependent on the movement of people and foreign financial goods[60]. Therefore, they depend on the attractiveness of their territory, a smooth functioning of tourism and transport infrastructures, and the good health of international banking institutions and flows.**

The economic fragility of Caribbean islands can also be explained by the persistence of a labour-intensive primary sector, disadvantaged by low technological development, by an underdeveloped secondary sector, and by a weakening tourism due to goods and people insecurity. The latter is, in fact, considered to be a structural brake on Caribbean economies, along with demographic ageing and public debt[61] (Yvars, 2019). **This economic fragility contributes to the low accessibility of climate changes data, as well as the low technical capacity of governments, a limiting factor for small islands** such as Dominica, St-Vincent-and-the-Grenadines (Robinson, 2018) and Trinidad and Tobago (Mycoo, 2020). Finally, it should be added that **the high exposure of Caribbean Island territories to natural risks such as seismic and meteorological hazards is a significant factor in their economic fragility, as funds dedicated to economic development are often reallocated to post-disaster reconstruction**.

[57] Such as Jamaica, the Dominican Republic, or Cuba, which fall below US$10,000/capita.
[58] The poverty line is set at US$3.2 per day in lower-middle income countries.
[59] During this same year, Puerto Rico benefited from a plan to restructure its debt, which amounted to over US$70 billion.
[60] (DGT, 2018b; DGT, 2018c; DGT, 2018d; DGT, 2018e; DGT, 2018f; DGT, 2018g; DGT, 2018h; DGT, 2019; DGT, 2022). Haiti is an exception in this respect, with an industrial sector representing more than 50 % of its GDP (France Diplomatie, 2022, 21 January).
[61] It should be noted, however, that some of the region's economic activities are not included in the official figures as they are in the informal sector.

The need for economic development, the first obstacle to mitigation and adaptation

At both national and regional levels, policies and programmes related to climate resilience in Caribbean islands are struggling to identify priorities and activate funding. Indeed, given their financial fragility, most Caribbean Island nations do not have the means to address the challenges of socio-economic development, climate mitigation and adaptation (Scobie, 2016). **As a result, national and, to some extent, regional policies turn away from climate issues to address, on an urgent basis, dysfunctional health and education systems, unemployment rates or trade deficits. It is in this sense that the fragile economic situation of the region's island states, and their low financing capacities, are seen as the main limitation to climate action** (Williams et al, 2020). When reviewing NDCs, countries identify the lack of economic and financial resources as one of the main constraints to climate changes mitigation and adaptation planning. When considering increasing the ambitions of their NDCs, the primary issue appeared to be the identification of financial resources (UNFCCC & RCC St. George's, 2020).

The dilemma between economic development and sustainable development is particularly acute in the energy sector. **While Caribbean islands are increasing their renewable energy projects[62], they remain extremely dependent on fossil fuels[63]. The same dilemma arises with regard to tourism, a fundamental economic sector in the region, but also an aggravating factor in the climate vulnerability of ecosystems and populations.** Thus, while the Caribbean islands are considered world leaders in sustainable tourism[64], they are also pursuing devastating tourism activities, including the construction of luxury resorts on coasts[65]. **Tourism therefore constitutes a double factor of vulnerability, illustrating the dependence of economic activities on weather and climate conditions, and the dependence of States on a polluting and highly emitting tourism model.** The economic fragility of these states is a brake on both mitigation and adaptation measures, anticipating hazards, but also on post-hazard crisis management measures. The paralysis of Caribbean islands and their dependence on external aid during the Covid-19 pandemic is a glaring example[66]. This fragility can also lead to the misuse of financial aid received following disasters, up to its diversion, as it was suspected concerning the US$13 billion received by Haiti after the 2010 earthquake (Mowla, 2021).

States awaiting international funding

This financial impasse is a recurring argument of governments in the region who, in anticipation of external assistance, struggle to develop financing plans. Moreover, they are not necessarily willing to do so, considering the principle of climate justice, basing their argument on the historical responsibility of developed countries toward climate changes. For this reason, a large majority of the resources mobilised for climate initiatives in smaller Caribbean islands come from external funding (Scobie, 2016). In fact, an analysis

[62] Barbados, for example, is seeking to become the first island state in the world to use 100 % renewable energy, while Jamaica is aiming for a 25 % reduction in emissions by 2030.
[63] With varying distributions, the energy mix of several Caribbean islands shows a very high dependence on fossil fuels: Cuba (81.31 %), Jamaica (90.88 %), the Dominican Republic (87.53 %), and Trinidad and Tobago (99.92 %) in particular.
[64] The Caribbean islands account for nearly 20 % of Green Globe members, particularly due to Jamaica, Barbados and the Dominican Republic (Green Globe, 2022).
[65] Like the "Peace, Love, and Happiness" complex, to be built in 2020.
[66] Faced with the Covid-19 pandemic, Caribbean islands lacked both technical and financial resources, the latter being exacerbated by the cessation of tourism. China quickly put in place emergency material and technical aid with the deployment of experts, the delivery of masks and medical equipment and, ultimately, vaccines. In contrast, the United States - even though geographically much closer - as much as Europe only provided financial assistance. The latter, although necessary, is most of the time much less visible, especially to the population (Constant, 2021).

of NDCs of Caribbean islands shows that **identified mitigation and adaptation actions are mostly not approached through the prism of national funding policies, but rather conditioned on the provision of international funding, currently considered too low**[67]. This lack of national financial commitment can be explained by the difficult economic situation of Caribbean Island States, as well as by a context of lassitude with regard to the countries of the North. The latter have disappointed their financial expectations and have not met the objective of mobilising US$100 billion per year for developing countries by 2020[68]. This central pattern to seek external funding does not only drive a lack of political will on the part of local governments, but also a **competition for funds between states and sometimes even internally, between ministries, which tends to undermine regional cooperation**.

This competition is also structured by inequalities of access. In 2020, Dominica, Saint Lucia and the Dominican Republic were not direct beneficiaries of either the Green Climate Fund (GCF) or the Global Environment Facility (GEF), while Antigua and Barbuda benefited from both funding streams (World Health Organization WHO, 2020). **Among difficulties that can compromise access to international funds, the most important are the lack of capacity related to the preparation of applications, and the lack of knowledge of funding sources** (UNFCCC & RCC St. George's, 2020). It should also be noted that overseas territories, as non-sovereigns, do not have access to these funds at all. Another example of the exclusion of certain islands from international funding is the 1997 Kyoto Protocol, which excludes French overseas territories from any funding, considering them under the aegis of the European Union. Thus, as the protocol provisions and measures do not apply to Saint-Martin and Saint-Barthélemy, these territories cannot benefit from the three programmes set up under this agreement, namely international emissions trading, the clean development mechanism (CDM) and joint implementation (JI). More broadly, the external finance model leads to a lack of policy coherence at the regional level, with funding being allocated to pre-defined projects that are not necessarily tailored to local needs (Scobie, 2016).

C- THE FRENCH ARMED FORCES AND CLIMATE CHANGES IN THE CARIBBEAN ISLANDS

1. Military capabilities vulnerability to climate changes

Vulnerability of French holdings and supplies

The French Armed Forces are present in the Caribbean islands through the ***forces armées aux Antilles* (FAA)**[69], with **permanent military components in Martinique and Guadeloupe**. However, their centre of gravity has narrowed over the last decade to Martinique, which is currently the only territory in the West

[67] For example, the 2020 update of Jamaica's NDC notes that, given the country's high level of indebtedness and the costly nature of these actions, they can only be achieved if sufficient financial resources are made available (UNFCCC, 2020, June). Similarly, the 2020 update of Cuba's NDC states that the country reserves the right to adjust its commitments if the financial or technological support provided is deemed insufficient to meet its commitments to developing countries under the Paris Agreement (UNFCCC, 2020).
[68] The failure to meet this commitment, made in 2015 at COP21, was deplored by the COP26 Presidency and led to the drafting of a *Climate Change Financing Implementation Plan* in 2022 by the Canadian Minister of the Environment and Climate Change, Jonathan Wilkinson, and the German Secretary of State in the Federal Environment Ministry, H.E. Jochen Flasbarth. According to this plan, the target should be reached by 2023.
[69] This presence in the island Caribbean is more fully integrated into the action of the French armed forces (Forces Armées aux Antilles and Forces Armées en Guyane) in Latin America and the Caribbean.

Indies to host naval and air capabilities. It should be noted, however, that the FAA do not have air capabilities of their own but benefit from a **drawing right on the fleet of the Armed Forces in Guyana** (*forces armées en Guyane, FAG*)**.** The islands of St. Martin and St. Barthélemy have no military infrastructure, as they do not host permanent military troops. The forces are spread over the following areas:

- Ten military sites in the municipality of Fort-de-France (Martinique), including Fort Desaix, headquarters of the FAA, and Fort Saint-Louis, a multi-training military site, hosting notably a naval base.
- Six military sites in the commune of Lamentin (Martinique), including the district of *Brière de l'Isle*, and the Pôle aéronautique étatique du Lamentin (PAE), an interministerial structure hosting French Navy, Gendarmerie and Customs Service aircrafts.
- Two military sites in the commune of Schoelcher (Martinique).
- Two training sites, respectively in the commune of Trois-Îlets and Le François (Martinique).
- A broadcast radio station in the commune of Rivière Salée (Martinique).
- The Dugommier camp in Baie-Mahault (Guadeloupe).

Due to their location in areas of high climate stress, **French military facilities in the region are exposed to environmental hazards**. The risk of **fire**, in and around military facilities, is increasing with the multiplication and lengthening of drought periods. Main military infrastructures are also located near coasts, in low-lying areas. **Fort Saint-Louis and the PAE, for example, are in the front line of flood risk, threatening the communes of Fort-de-France and Lamentin** (DEAL de la Martinique, 2014). **The gradual sea level rise as well as extreme weather and climate phenomena multiplication and intensification of extreme weather and climate are factors in the deterioration of safety and security conditions of coastal areas holdings.** The French presence in the Caribbean depends primarily on these military holdings, as much as on ports, of prime geostrategic importance.

The geological and urban environment of military camps contributes to their vulnerability. Fort-de-France, for example, is **landlocked on** one side by the bay and on the other by the rapidly rising elevation of the terrain. This landlocked isolation, accentuated by concentrated and cramped urbanism, restricts an already dense traffic to **a single road axis**: the A1 highway. Thus, if a climate or meteorological hazard were to cut this axis, the link between military sites and the airport and port could be interrupted. **Maintaining this link is essential**, not only for the population, but also for the French forces, as the supply of military equipment in the West Indies is essentially ensured by metropolitan France and French Guyana, by air and sea. **The road connection with the airport and the port is therefore essential for maintaining supply routes. This is even more crucial in view of the growing competition for local resources in the West Indies.** The reduced availability of water resources, for example, could lead to their monopolisation by local populations (Breton, 2022), pushing armed forces to mobilise part of the water resources of the mainland. **This growing dependence on the mainland could be a destabilising factor for the FAA**.

Equipment vulnerability

Rising air and water temperatures as well as sea level rise can also affect equipment durability. Mechanical systems, such as motors, and electronic systems, including batteries and other heat-sensitive components, are expected to require increasing cooling capacities in the face of rising exposure to extreme temperatures.

For example, high temperatures induce premature wear and tear of battery and cell energy storage systems. Lithium-ion batteries in particular are very sensitive to thermal hazards (Ouyang et al., 2019). All at once, they represent a major challenge for the French army, which commit to have a 50 % electric or hybrid fleet for its administrative vehicles by 2030 (Perret and Laurent, 2022). **Thermal problems also arise for air fleets, as high temperatures could affect the carrying, take-off, flight and landing capacities of aircraft** (Maisonneuve, 2022). For its part, the US military identifies technologies related to data communication, ground and space-based sensor tracking, drone swarm control, and autonomous command and control systems as potentially affected by extreme temperatures and weather events (Stanley, 2021). **The intensification of these phenomena could in this sense affect the ability of armed forces to obtain information.**

As for the increase in water temperature, it leads to an **increased evaporation** phenomenon. **This would contribute in part to increase the humidity of the air and thus increase the cloud cover**. This increase can represent a **risk in the aviation sector**. One example is the induction of icing at altitude (Ministère des Armées, 2022), affecting flight and precision-guided munitions performance (Gautam, 2009). With regard to marine equipment, **warming waters can lead to problems with propulsion engines cooling in ships**[70] (Maisonneuve, 2022). Combined with water acidification, particularly marked in the Caribbean, it also increases *biofouling* communities[71](Dobrestov et al., 2019). **These communities of microorganisms slow down the progress of ships, increasing the frequency of their dock stops and their energy consumption** (Regaud, 2022). A final example of climate changes impacts on marine equipment could be found in the **increased power and severity of Atlantic waves (Reguero et al., 2019)**, which represents a new challenge for sea users, including warships (Engel, 2022). **The need for more frequent replacement of equipment or its optimisation through new manufacturing processes will be experienced and assessed while considering the phenomenon of resource scarcity[72] and the evolution of civil environmental and energy standards.**

Soldier vulnerability

New pressures and demands on infrastructure and equipment set new challenges to soldiers' physical resilience. With rising temperatures in the Caribbean, **armed forces are particularly at risk of heat stroke, leading to significant performance losses (Kjellstrom et al, 2009), as well as increased risks of accidents and dehydration.** Beyond symptomatic exhaustion, overexposure to heat can have a lasting effect on the health of soldiers through **clinical diseases**[73], in particular kidney disease (Kjellstrom et al, 2009). In this regard, the prevalence of kidney disease in a tropical country close to the study territories - Nicaragua - has already been highlighted (Gallo Ruíz & García Urbina, 2017). To quantify the impacts of heat exposure on health and well-being, heat stress indices and associated protective guidelines have been developed. The most used is **the *Wet Bulb Globe Temperature* WBGT index**[74], developed by the US Army to protect soldiers in training from

[70] The primary circuit of the latter is always cooled by seawater.
[71] Accumulation of microorganisms on the hulls of ships.
[72] This concerns critical mineral resources such as lithium, essential to the arms industry.
[73] In Thailand, cases of exertional heat stroke have also been reported among soldiers in training (Supaporn, et al., 1992). They were exposed to high fevers, cardiovascular, circulatory, respiratory, digestive and blood coagulation failure, platelet depletion, acute renal failure, and sometimes death (Meekangwan et al., 1990, cited in Kjellstrom, T et al., 2016).
[74] This index takes into account air temperature, radiant temperature, humidity and air movement. It assesses how long a worker can be active, and how much rest is needed to cool the body and keep the body temperature below 38 °C.

dangerous heat stroke (US Department of the Army and Air Force USDAAF, 2003). According to this indicator, **the Caribbean area is among the most at risk** (Smith et al., 2014).

Thus, the rising temperatures in the region pose a real risk to the health and activity of soldiers, who are made more vulnerable to heat stroke by intense physical effort and heavy clothing. In addition, the issue of heat exposure is **correlated to increase water supply need**, which could be compromised in a region affected by water stress and competition for water. Furthermore, the geographical spread of previously assessed **infectious diseases,** such as dengue or chikungunya, exposes soldiers to an increasingly wide and virulent range of pathogens (Breton, 2022). Finally, the physical and psychological exhaustion of soldiers is likely to be amplified by a **phenomenon of overwork** (Nexon & Sénéquier, 2022), which may be induced by the overstretching of forces in the face of climate changes. This is examined in the following developments.

2. Armed forces under greater pressure to deal with climate changes

Complexity of existing missions

While climate changes in the Caribbean are reshaping capabilities of armed forces in many ways, it is also re-articulating the way in which these capabilities are called upon; in other words, the missions of the forces and the geopolitical and security context in which they operate. One of the main missions of the *FAA* is to provide **assistance and relief to the population in the event of a natural disaster** (*Humanitarian Assistance and Disaster Relief*, HADR). For example, the operation Irma mobilised 800 soldiers following the destruction of 95 % of the buildings on the island of Saint-Martin in 2017. The need to maintain the level of intervention of the forces in the context of an extreme meteorological and climatic event was reaffirmed during the joint and allied exercise "Caraïbes 2022"[75] (*« Caraïbes 2022 »: dix aéronefs français et étrangers déployés aux Antilles*, 2022). **The significant use of the air fleet in this exercise illustrates its vital importance for the relief of populations in the West Indies**, while French military power and organisation is mainly maritime**. This primarily maritime configuration, at the expense of an airborne organisation, was a limiting factor for the armed forces during Operation Irma, which would have required a better sea/air continuum in the face of unpredictable threats**[76] (Arnel et al, 2018, 24 July).

The upcoming multiplication of extreme weather and climate events not only progressively increases the frequency with which French armed forces will be mobilised for this type of mission, but also makes the main line of action of French forces in the region more complex. These include the fight against trafficking at sea, particularly drug trafficking and illegal fishing, by means of the Ventôse and Germinal surveillance

[75] From the 7th to 17th of June 2022, French and foreign air assets are taking part in the FAA's "Caribbean 2022" joint and combined exercise based on a scenario with a first hurricane over Guadeloupe on the 8th of June, and a second over Saint-Martin on the 15th of June.

[76] During storm Irma, there was a strong dependence on airborne resources and external reinforcements, with the setting up of an air bridge in the Antilles to mobilise additional resources. The peak of the gendarmerie's manpower was quickly reached. In view of the scale of the crisis, the armed forces were mobilised, including those present in West Indies, but also reinforcements from France, notably with the use of the A400M. An air bridge was set up: aerial reconnaissance (FA50), Casa aircraft, light information helicopters for humanitarian transport, Airbus A400M, for massive logistics, and DéTIA (inter-army transit detachment). The intervention of armed forces lasted almost two months in the form of emergency projection and summary recovery. The level of commitment was unprecedented in a context of extreme urgency and in degraded environmental conditions - at the meteorological, security and health levels (Arnel et al, 2018, 14 July).

frigates. These missions are conducted by the FAA in cooperation with the United States[77] and European partners[78], mainly the Netherlands[79] and the United Kingdom[80]. The forces involved have to deal with increasingly frequent extreme weather events compromising their surveillance missions, from changing itinerary to necessary mooring, by affecting their visibility through swells and rough waters. Moreover, they can find themselves mobilised, at a post event situation, to deliver humanitarian cargo, keeping them apart from their surveillance mission. In addition to these tangible changes in the physical environment of operations, climate changes also tacitly transform human behaviour.

In this sense, the increasing complexity of defence and security missions is also a function of more subtle socio-economic transformations, related to climate changes' impact on certain sectors of activity, first and foremost agriculture. For example, we can anticipate that **some producers** will **gradually abandon food crops and convert to the cultivation of psychotropic plants**[81], because of their greater resistance to climate changes[82]. The food crops decline in the region in favour of psychotropic plant market is expected to intensify considerably over the next few decades and is an indirect factor in the intensification of drug trafficking in the area. The French Senate, in a 2011 information report on institutional developments in Martinique, French Guyana and Guadeloupe, identifies an **increase in drug-related violence and activities as well as inillegal immigration linked violence** (Cointat & Frimat, 2011, 6th of April). A second and more recent information report of the French Senate on Overseas France states that illegal fishing activities are increasingly violent and that, in response, operations of French armed forces to stop them can be compared to 'war operations' (Folliot et al., 2022, 24th of February). Although the fight against illegal fishing has so far been carried out mainly by the Armed Forces in Guyana, fish stock depletion is expected to lead to the gradual expansion of illegal, unreported and unregulated (IUU) fishing throughout the Caribbean, and particularly Caribbean islands. However, efforts of the French forces to control illegal activities could be limited by a variety of demands, particularly HADR demands.

Diversification of missions

Climate changes has not only made historical missions of the French armed forces in the Caribbean more complex, but also led to the appearance of new missions, primarily HADR ones. Since the 2000s, there has been a **growing demand on forces to deal with epidemic hazards**, manifested in the region by malaria, chikungunya, West Nile fever, filarosis and dengue fever proliferation, strucking the region in August 2010. In 2010, armed forces, and more specifically the adapted military service (s*ervice militaire adapté*, SMA), were mobilised to support epidemic vector control teams and human resources invested by Guadeloupe and

[77] The FAA coordinates with the US Joint Interagency Task Force-South, participates in the US-led Carib Shield operation and leads the Carib Royal and Atlantic Watch operations, under the aegis of the US.
[78] The M.A.O.C-N (Maritime Analysis and Operation Center-Narcotic) is a form of extension of the fight against drug trafficking in the Caribbean, on the Atlantic coast, and is composed of the military of the participating European countries and the armed forces of the US Joint Interagency, Cape Verde and Morocco with observer status.
[79] The FAA participates in the Dutch-led one-off Carib Venture operations.
[80] The OFAST (*Office antistupéfiants*), based in Fort-de-France, has foreign liaison officers including British, Spanish and American.
[81] This has been observed in Afghanistan, where opium production has increased significantly due to prolonged drought (Parenti, 2015). The same observation can be made in Central America where researchers are beginning to link climate changes, poverty and the cultivation of psychotropic plants (Weisz Argomedo, 2020). The yield decrease in legal crops (cocoa, coffee) is indeed driving competition for the cultivation of psychotropic plants, for example in Peru (Hungerbühler, 2020).
[82] Most psychotropic plants (*Erythroxylum coca* from cocaine, *Cannabis Sativa subsp. indica* from cannabis and *Papaver somniferum L.* from heroin) appear to show high resilience to the effects of climate changes, including rising temperatures, drought and increasing atmospheric CO_2 (Acock et al., 1996; Rury, 1980; Chandra et al, 2008; Ziska, 2008; Jeena, 2008; Yıldırım et al, 2016).

Martinique local authorities to carry out mosquito control operations[83] in schools (Le Monde & AFP, 2010). The duration of the epidemic was exceptionally long - 47 weeks - with almost 84,000 estimated clinical cases in Guadeloupe and Martinique, and a particularly high lethality in Martinique (Santé Publique France, 2011). A more recent example is the health mobilisation in response to the Covid-19 pandemic, which requisitioned armed forces of 95% of the world's states (Erickson et al., 2022), and generated a political will to bring health care closer to security and defence tools and resources. In the West Indies, French armed forces have been involved in the evacuation of serious cases, the transport of medical equipment[84] and the deployment of bacteriological risks specialists' teams (Julien, 2020, 4th of April; AFP, 2021, 15th of August). The implication of armed forces in the HADR framework must also be seen in the light of the increasingly intense and diversified demand on civil security forces, for example in the face of the **increase in bushfires**[85]. Finally, although French Armed Forces already carry out rescue missions for populations in the context of extreme weather and climate events, **risks weighing on industrial infrastructures and associated pollution are likely to be taken more into account**. In March 2022, the Commander of the Antilles maritime zone organised a crisis management exercise at sea entitled "BLUE HAVEN", staging a possible oil spill from a ship off the coast of Guadeloupe (Directorate of Operations of the Ministry of Defence, 2022, 23 March).

Climate changes as a factor of insecurity in the area

The social, political and economic fragility of Caribbean islands as a result of climate changes leads to growing insecurity in the area. At the intra-state level, **competition for essential resources**, particularly water, food and energy, is likely to lead to clashes within populations and between various sectors of activity for their monopolisation. Furthermore, local populations resentment could be amplified by the rapprochement with regional organisations, a strengthening of cultural identification with the Caribbean, and the demand for a more substantial financial commitment from the mainland. In this sense, **the contestation climate in French West Indies must be taken into account as a potential destabilising factor**. In 2011, General Claude Vicaire, commander of the French overseas *gendarmerie*, indicated that the risk of aggression against *gendarmes* in overseas France was already twice as high as in mainland France and that weapons were used more frequently (Cointat & Frimat, 2011, 6 April). Besides, **climate changes are notably amplifying the parastatal phenomena that sustain violence in French West Indies, among which we can primarily count the consolidation of gangs, the increase in trafficking and the rise in corruption and crime due to livelihoods weakening** (Mowla, 2021)**.**

At the inter-state level, competition for public goods and natural resources is deteriorating relations between Caribbean islands. **Tensions over fish stocks** are already visible in neighbouring areas[86] and are expected to increase with the effects of climate changes on fish stocks. A similar competition can be observed around dwindling land, as the amplified tensions between Haiti and the Dominican Republic around the island of Hispaniola (Alscher, 2010). **These tensions, together with massive migratory phenomena in**

[83] Removal of mosquitoes and their larvae.
[84] More than one million surgical masks, several hundred litres of hydro-alcoholic gel and several tonnes of medical oxygen were brought in.
[85] Fire of herbaceous vegetation and bushes affecting in particular numerous agricultural lands in the Caribbean.
[86] In 2019, Surinamese authorities arrested five Guyanese for fishing in their EEZ. In 2021, French authorities off French Guyana arrested a Venezuelan fishing vessel in its territorial waters with illegally caught red snipers (Mowla, 2021).

response to natural disasters, create an environment conducive to conflict and insecurity[87]. The Caribbean islands space is further fractured as the impoverishment of the islands reinforces the **interest in bilateral relations, from which they hope to draw economic support**. Climate changes thus favours the strengthening of the Chinese presence in an environment, economically and geographically close to the United States. It has led to diplomatic divisions within regional groups, whose cohesion is essential to deal with climate changes, and to the **risk of a Sino-American conflict.** The *FAA* will have to operate in a crisis environment that is both precarious due to climate changes and bipolarised by the presence of these two antagonistic powers.

[87] On the island of Hispaniola, the migration of Haitians to the Dominican Republic due to environmental degradation leads to tensions, xenophobia and potential violence (Alscher et al., 2010; Vietti & Scribner, 2013).

SCENARIOS

The second part of this brief consists of **three prospective scenarios** which highlight the geopolitical and security challenges of climate changes in the Insular Caribbean. The design of these scenarios required the selection of the most influential variables to date and those likely to be influential in the future within the Caribbean islands. Twenty-four environmental, political, economic, security and social variables were first selected and compared to assess their mutual degrees of causality. In this way, it was possible to identify the most influential variables – those that have the highest effectivity on the largest number of variables - and the most dependent ones - those that are most highly influenced by the largest number of variables.

These three scenarios take the decade 2040-2050 as their time horizon, and are geographically located in the Caribbean arc, with a particular interest in the Lesser Antilles and its French territories. Their narrative variations are based on the **IPCC's *Shared Socioeconomic Pathway 3* (SSP3)**. It foretells an **increase in regional rivalries and a retreat to national priorities**, especially concerning the energy and food sector, relegating to background education and technological development. This coupled with the deterioration of international cooperation leads to difficulties both in climate mitigation - due to a lack of technical evolution and states 'dependence on fossil fuels in a context of decreasing international commitments - and in climate adaptation - due to a limited human development in a context of weakened growth and inoperative regional and international organisations. Furthermore, the SSP3 projection assumes that global annual CO_2 emissions will exceed 60 Gigatonnes between 2040 and 2050. The resulting global average air temperature warming for the period 2041-2060 compared to the pre-industrial period is estimated at 2.1°C

The choice of the SSP3 projection arises from a global and regional analysis of the evolution of international cooperation on climate changes mitigation and adaptation. Sino-American competition, climate changes conferences' failures and low Caribbean cooperation, undermined by both the expectation of international financial support and the struggle to capture it, lead to the development of regional rivalries. Lack of financial resources and insular vulnerability reinforce the hypothesis of **a prioritisation of efforts toward resources access-** particularly **energy and food** – over efforts toward mitigation and sustainable development, which require long-term investments in financial, human and technological capital.

Baseline scenario: the rise of popular protests

The deterioration of climate conditions in the Caribbean is weakening island systems. Local populations see their livelihood reduced and question the political legitimacy of their leaders in a general context of economic and security crisis. Tensions between states are increasing because of migratory movements and undermine regional cooperation on climate mitigation and adaptation. The French armed forces are in great demand to support law enforcement and civil security forces.

The economic crisis in the insular Caribbean

None of the Caribbean economies are spared from the effects of climate changes, with a major impact on their main sectors of activity. Indeed, **rising temperatures and reduced rainfall increase the share of**

agricultural losses and force the abandonment of crops that are no longer fit to the local climate conditions, such as cocoa and bananas. Fishery resources are also threatened by the **collapse of fish stocks**. Sea level rise and coastal erosion lead to the destruction or desertion of 20% of the region's tourist infrastructures. **Due to the loss of coral reefs (95%), degradation of coastal areas and climate and weather conditions, tourism activity has halved in a decade.** Declining arrivals coupled with an increase in costs, notably linked to the investments needed to repair infrastructures, to protect the coastline, and the increase in insurance costs result in a drop in tourism profit. The drastic decline in agricultural and tourist yields causes the **collapse of Caribbean economies**, particularly the Bahamas, where 35% of the territory has been flooded, and Dominica and St. Vincent and the Grenadines, which are seeing their debt levels soar. The populations of the Caribbean islands are thus experiencing massive impoverishment. Unemployment, especially among young people, rises sharply, as is the proportion of the national population living below the poverty line. Rising temperatures are also causing an increase of more than 60% in the number of people under **water stress** in the small island developing states of the Caribbean. In addition, there is **competition for access to water between local populations and tourists,** since the arrival of tourists is perceived as an additional pressure on resources. **The livelihoods of the populations are further weakened by the fact that some of them, living in coastal towns exposed to flooding, are forced to relocate.**

Contested political legitimacy

The impoverishment of populations, their relocation, and the associated increase in crime lead to episodes of violent protests throughout the Caribbean during the hot season, marked by energy instability. In Cuba, electricity is restricted to extremely reduced time slots, with regular blackouts lasting several days. **Population uprisings caused by this energy instability are massively repressed by the authorities**. Violence is also striking Haiti: **the growth of Haitian gang's influence and resources** due to the massive development of drug and arms trafficking on the island has not been controlled by the central state. The assassination of the new Haitian President in 2038 after more than a decade without any election led to a failed state controlled by gangs. Being an ideal transit point for migration to the North American mainland, Puerto Rico is facing a massive influx of migrants from the southern Lesser Antilles. As the **migratory pressure** spills over to the United States, the latter is urging Puerto Rico to close its borders, but without providing any additional support resources. Puerto Rico, powerless in the face of the migration crisis, is demanding to be fully integrated as a US state, but this demand is ignored by the federal state. This diplomatic impasse paralyzes the management of illegal migration flows. Fears that the United States' threat to permanently close its borders with Puerto Rico will be carried out is raising. **Anti-American protests**, sometimes violent, are growing in number in the cities of San Juan, Ponce, and Mayagüez. **In the French West Indies, the deterioration of living conditions due to impoverishment and increased exposure to climate risks is compared to the situation in France mainland.** The growing inequalities reinforced **resentment against the central state**. The Puerto Rican case offers an example that is taken up by Caribbean independence fighters. The sharing of the Creole language with several neighbouring islands brings together Pan-Caribbean independence groups in Guadeloupe, Dominica, Martinique, and Saint Lucia, rearmed attacks against representatives of the authorities are becoming increasingly frequent.

The end of regional cooperation

Chronic migratory pressure in the region, due to economic and political fragility, are punctually accentuated by massive movements during weather and climate events. This results in restrictions on arrivals, sometimes leading to physical violence located at land borders: the wall separating the Dominican Republic from Haiti has been raised several times following climb attempts, which led Dominican forces to open fire on civilians. **Illegal migration by sea has then developed**, from Haiti to the Dominican Republic, but also from all the Caribbean islands to the United States. The presence of the Bahamas and, to a lesser extent, the Turks and Caicos Islands on the way to North America led both states to increase their coastal protection forces. It regularly results in incidents and illegal boats capsizing. Due to fewer restriction, human flows to Cuba and Haiti have increased sharply, the two states acting as intermediate hubs to get closer to the US. **This position accentuates the destabilising character of Cuba and Haiti and further isolates them within their region.** While the objective of most migrants from the southern Lesser Antilles is to reach North America, the illegal transit of populations through French territories leads to long-term settlements, made easier by informal urbanisation. **Migration tensions between states accentuated by their lack of financial resources are turning them away from regional cooperation**. Moreover, competition for international funding limits projects pooling and information sharing on climate mitigation and adaptation. The same counter-cooperative phenomenon occurs with regard to attracting foreign direct investment, particularly from the United States and China. Several Caribbean states will leave the common market as early as 2035, in order to maintain the stability of their banking activities (such as the Cayman Islands in 2035) or to strengthen a privileged relationship with the United States, the latter being concerned about Caribbean economic instability (such as Grenada in 2038). Asa matter of fact, China's presence in CARICOM increases proportionally to its investments in the member states that stayed in the organisation. There is a **complete polarisation of the Caribbean between countries associated with the US and those associated with China**.

French armed forces operability compromised

The difficulties experienced by the agricultural and tourism sectors have encouraged the development of drug trafficking. The insular Caribbean's role as a hub for international drug trafficking is growing, while **regional cooperation, essential in the fight against drug trafficking, has stalled**. While the decline in tourism limits *go-slow* opportunities due to the decrease in boaters' number, the failure of regional cooperation reinforces the effectiveness of *go-fasts,* thus more difficult to intercept without intelligence sharing. This is especially verified for short distance traffic between islands of the Lesser Antilles, where several narco-states[88] are developing, such as Saint Kitts and Nevis. In these islands, the law enforcement agencies benefit directly from the incomes of drug trafficking while contributing to it, at least passively, which encourages similar phenomena in neighbouring islands. **The recentralisation of the Caribbean in international drug trafficking and the predominance of *go-fasts,* intensifying innovation in maritime transport, reinforce the importance of the armed forces' maritime intervention capacities.** At the same time, popular protests, which fully mobilise the law enforcement agencies, lead to an institutionalised collaboration between the Ministry of the Armed Forces and the Ministry of the Interior around the **reallocation of internal security missions to the *FAA*. The latter are notably mobilised in the fight against arms trafficking and bush fires in the framework of advanced cooperation with the civil security forces**. In addition, dengue epidemics trigger

[88] A narco-state is defined in 1994 by the Observatoire Géopolitique des Drogues as a state whose "sectors (...) benefit directly, for a significant or even essential part, from the revenues of narcotrafficking." (Bray, 2012).

missions of transport of patients to France mainland, mobilising part of the air force, but also **missions of water distribution to the population and elimination of stagnant water storage.** In 2042, due to a particularly long epidemic, the exposure of military personnel in the fight against the spread of dengue led to the hospitalisation of 10% of the personnel. In the face of several additional demands, the **uncertainty about the operability of the entire workforce in the event of a general emergency mobilisation raises questions about** the order of priority of the armed forces' missions in the West Indies.

Disruptive scenario - The Return of the Cold War in the insular Caribbean

China is taking advantage of the region's severe impoverishment by investing heavily in strategic sectors, supported by the financial disengagement of the United States. China's growing influence is causing bipolarisation in the region, tensions between states, as well as tensions between the populations of sub-national jurisdictions and their home states. Extreme temperatures in the summer of 2045 cripple the energy infrastructure of several islands, including Martinique and Cuba. The presence of a Chinese naval vessel intended to help Cuba quell the military uprising caused by the government's loss of legitimacy leads to an escalation of Sino-American tensions and a call for NATO's collective defence against a backdrop of bloc logic, reminiscent of the Cold War that began a century earlier.

Regional impoverishment as a vector for increasing Chinese presence

As a result of climate changes, **tourism, agricultural and fisheries incomes are declining by more than 20%, causing massive impoverishment of the population and the indebtedness of the region's states, forced to incur debts in order to avoid bankruptcy.** At the same time, **energy production and distribution infrastructures**, ageing and heavily affected by rising temperatures, **require major** highway **adaptation work.** Furthermore, climatic hazards and cyclone periods raise these costs. In this context**, opportunities for adaptation depend directly on foreign investment. The Caribbean region is especially opening up to Chinese investment**, mainly directed towards strategic sectors. Thus, in 2080, China has control over six ports - notably Freeport in the Bahamas, Kingston in Jamaica and Port-au-Prince in Haiti; numerous power plants in the region, representing respectively 40%, 55% and 75% of the electricity mix in Dominica, Jamaica and Cuba; as well as the entire distribution networks of the latter two. **In the French territories, China is also investing in electricity networks and road infrastructures, which are suffering from rising temperatures.** One of those Chinese companies has become the only non-metropolitan French highway: the A1, located in Martinique, following the bankruptcy of the Martinique concession. Beyond economic considerations, one can see the strengthening of Sino-Cuban cooperation in political and military matters. Thus, Cuban officers training is partly provided by China, located in Cuban and Chinese territories, and Cuba benefits from the delivery of anti-submarine warfare equipment in the name of the Caribbean drug trade. This cooperation repeatedly causes strong reactions from the United States, which threatens to deploy its fleet.

Rising temperatures cause tensions to explode

In the summer 2045, unprecedented temperature peaks are reached in the insular Caribbean, exceeding 45°C and going up to 50°C. Facing such temperatures, **the preponderance of thermal energy in the region**

along with a lack of investment in combustion plants and ageing electricity grids, induces long and frequent power outages. In Cuba, a widespread power cut hits the country, reviving the deep rejection of the authorities by the population. Protest attempts, in the form of **street demonstrations** and social networks speaking out, are thwarted by repressive measures, supported by China which is in control of the Cuban Internet network. The Cuban blackout isolates the population from the outside world, making it difficult to gather evidence of the violent repression. **The extreme deterioration of the Cuban internal situation leads to the uprising of several hundred military soldiers**, endangering the regime, which fears that it would spread to the entire forces and population. The protest movement immediately receives **public support from the United States,** which claims being ready to offer material and logistical support to the military. In Martinique, an explosion at a fuel depot causes a breakdown in supplies and the shutdown of the Pointe des Carrières diesel power station, inducing the mobilisation of civil security forces to control the fire, as well as the paralysis of the Martinique University Hospital, left without electricity. **In the context of a major strain on the health services, already facing a dengue fever epidemic, the armed forces based in Fort-de-France provide their own fuel until supplies are re-established by a cargo ship from French Guiana.** Electricity is finally restored after a few hours but power failures recurrence along with insufficient and irregular water supply, take part in popular discontent and resentment towards the mainland.

Cuban escalation and the return of the Cold War to the Caribbean

Cuba requests China's help in restoring order and publicly denounces US interference, designating the American enemy as a destabilizing factor in the area. China responds favorably to the call and promises substantial aid to the Cuban state in the face of external destabilisation attempts**. Cuba also announces the strengthening of its military cooperation with China to guarantee the country's internal security.** A Chinese-Cuban listening station designed to intercept exchanges between the outside world and Cuban opponents is set up in Havana, while a Chinese navy ship is sent to support Cuba in its waters to prevent outside intervention. **The United States considers the departure of a Chinese naval vessel towards Cuban waters and the establishment of the listening station as a direct threat to its sovereignty and asks NATO's allies to adopt a posture of deterrence** and to be ready for the activation of Article 5. Part of the US fleet is deployed in their territorial waters. As a matter of fact, China indirectly threatens the US through its control of several commercial ports: the Freeport container port in the Bahamas, the Port of Kingston - with a concession until the year 2066 - and its free port, Kingston Freeport Terminal Limited - with a concession until the year 2050 (Constant, 2021). The deepwater port in the Bahamas, which is the deepest of the insular Caribbean, is owned by Hutchison Port Holdings, close enough to the Chinese power that the regime has been able to indirectly control the infrastructure since the 2010s. A US interference coming to light or intervention in Cuba, could result in the closure of these ports to US-bound and originating ships as a retaliatory measure. In addition, as a result of increased economic and political cooperation between China and the Bahamas, and between China and Jamaica over the past decade, Chinese military vessels are invited to call at or station in these countries' ports.

French paralysis

In Martinique, the supply of the Pointe des Carrières diesel plant by the armed forces must be extended. The ship which is bringing the fuel indeed experiences difficulties in docking, due to infrastructural failures in the

port of Fort-de-France caused by a flood a few months earlier. While the United States calls for the deployment of NATO member navies, **France states not being able to intervene immediately because of its lack of energy resources and the partial mobilisation of its armed forces for the fight against dengue fever and for food distribution to the population**. At the same time, the United Kingdom and the Netherlands respond to the United States' call and deploys their fleets in the northern Lesser Antilles, where their sub-national jurisdictions closest to Cuba are located. **The three States declare the birth of the NEUKUS alliance, from which France is *de facto* excluded**. The United States denounces France's non-commitment, rejecting its argument of lack of resources and military personnel, to rather blame China's control of its strategic infrastructure, notably the A1 highway, a vital road for the French armed forces. **The perception of French dependence on China by the US, the UK and the Netherlands** is further amplified by the speech of the President of the People's Republic of China, who welcomes the French position. Among the people of the French West Indies, supply constraints are not identified as a cause and the non-deployment of troops is seen as a manifestation of France's desire to maintain a neutral status in the region, which they approve of : these islands benefit daily from Chinese investments. In contrast, the Netherlands and the UK are challenged by their populations, who accuse them of threatening the financial lifeblood of the region. Despite the approval of its population, **France finds itself isolated from the rest of the insular Caribbean, publicly denounced by the Western alliance, and weakened by the disparate mobilisation of its armed forces, the strain on its energy resources and the Chinese takeover of its local infrastructure**.

Disruptive scenario: the nuclear accident in Florida

The Turkey Point nuclear accident

During the night of 9-10 July 2043, a category 5 hurricane hits Florida. To everyone's surprise, it moves eastwards to hit the Bahamas the next day, and finally Cuba on 12 July[89]. These territories are subjected to destructive 350km/h winds and very significant flooding in coastal areas, linked to sea level rise, which has reached 5 to 15 metres. On the 15th of July, a category 3 hurricane hits Haiti and the Dominican Republic with winds of nearly 200km/h. Major flooding phenomena also affects the coasts. Finally, on the 16th of July, a category 2 hurricane hits Puerto Rico and the northern half of the Lesser Antilles, affecting Saint-Martin and Saint-Barthélemy in particular. Violent swells are felt as far as the coast of Guadeloupe. **In Florida, a large part of the electricity network, still under repair due to a category 3 hurricane passing a month earlier, is damaged. This causes a widespread blackout** and the disruption of the network's interconnection with neighbouring states - Georgia and Alabama. Two days before the hurricane hit, the two nuclear power plants in Florida - St Lucia and Turkey Point - were shut down. However, damage to Florida's power grids put the cooling systems of Unit 3 of the Turkey Point plant at risk. The **failure of the islanding procedure and the unavailability of the emergency generators, deteriorated and overstretched by frequent weather events, lead to the explosion of the reactor on the morning of the 10th of July**. The power of the hurricane and the resulting necessary lockdown of the population prevent the deployment of the civil security forces, who must

[89] The usual hurricane track is east-west in tropical latitudes, with a bend to the north. However, according to some atmospheric studies, this track is likely to change in the North Atlantic as a result of climate changes (Knutson et al., 2022; Garner et al., 2021). The shearing winds mentioned earlier are also likely to contribute to a change in this track.

wait nearly four hours before being able to intervene in the power plant fire. The fire releases large quantities of **radioactive particles, which are rapidly disseminated by the hurricane's strong winds over a 300km radius**, particularly in Biscayne Bay, the Gulf of Mexico and the Caribbean Sea. The International Atomic Energy Agency (IAEA) quickly raises strong suspicions of contamination throughout the Caribbean islands as the hurricane moves through the area.

The US withdrawal and the rise of regional cohesion

On the 11th of July 2043, the President of the United States, accompanied by the Chairman of the US Nuclear Safety Authority, publicly assesses the Turkey Point nuclear accident. In this speech, **the risk of contamination beyond US territory is ruled out, and only internal evacuation strategies are put in place, despite the warnings issued by the IAEA.** The US position, permitted by the **legal uncertainty surrounding radiation protection at an international level**, arouses the indignation of the Caribbean Island states. This reinvigorates cooperation within CARICOM. **On the 12th of July, as the hurricane hit Cuba, the CARICOM asks for immediate logistical and financial support from the United States for the evacuation of the Bahamas, whose health care and transportation infrastructure have been destroyed.** More broadly, the CARICOM requires US participation in the evacuation of the entire hurricane-affected territory as soon as the hurricane is over, if abnormally high levels of radioactivity are to be detected. Despite a commitment in principle, the United States delays sending relief supplies to the Bahamas until the 16th of the month, and refuse to provide any assistance to Cuba, even though the country reported high levels of radioactive contamination on the 13th of July. Indeed, the US accuse the Cuban government of deliberately lying, in order to weaken Cuba diplomatically, and further spread its ideology in the region. The **US refusal to deal with the repercussions of the nuclear crisis in the insular Caribbean provides a new opportunity for China to gain a foothold in the region**. Thus, Chinese planes and helicopters start to land in the Bahamas on the 13th of July, delivering first aid and nuclear protection equipment. Specialists in nuclear crisis management are also sent. China similarly intervenes in Cuba, Haiti, and even Puerto Rico, further fuelling Sino-US tensions, as well as tensions between Puerto Rico and the US. **The Chinese handling of the Puerto Rican crisis will signal the final failure of the island's integration into the US federal state.**

The French West Indies in the face of the hurricane

On the 13th of July, following the passage of the hurricane over Cuba, and ahead of its arrival on the islands of Saint-Martin and Saint-Barthélemy, **the Elysée announces that no evacuation of the population can be ensured considering the meteorological and climatic conditions. It also claims that the decision will depend on the American conclusions and international investigations,** as well as on French investigation, to be launched the soonest possible. The US statements are not officially questioned, despite the IAEA's concerns. The populations of the French West Indies are nevertheless urged to prepare for evacuation, which could be decided at any time. **The French decision to wait for the hurricane to pass causes panic among the population, alarmed by the distribution of iodine tablets by the armed forces.** Informal evacuation movements began on the 14th of July, as Saint-Martin and Saint-Barthélemy population are seeking to reach Guadeloupe, while the hurricane is approaching. It leads to the capsizing of several makeshift boats off Antigua and Barbuda, Montserrat and Guadeloupe, due to the violent swells as the hurricane approaches. Around thirty deaths are reported, and on the 16th of July, another 170 people die as a result of the hurricane

passage on the islands of Saint-Martin and Saint-Barthélemy. **The islands are destroyed, and the violent winds blow as far as the coast of northern Guadeloupe and cause in Port-Louis and Baie Mahault.** A feeling of distress is spreading among the population, aware of the impasse in which they find themselves. In addition to the preoccupation around high reconstruction and relocation cost, the suspicion of contamination raises many concerns: **the islands see their food resources - whether agricultural products, fish stocks or drinking water - reduced to nothing or suspected of being toxic, and instantly lose their status of heavenly tourist destination.** On the 17th of July, the UK claims to have detected abnormal levels of radioactivity in Antigua. **China then officially reaffirms the spread of radioactive contamination by the United States in the Caribbean and offers financial and logistical assistance to France.** France claims being ready to accept this help if the suspicions of radioactivity are confirmed on its territory. In addition, the French Nuclear Safety Authority announces the immediate launching of an investigation into all French territories in the Caribbean islands.

The evacuation of the population by the French armed forces

On the same day, **the FAA evacuate the populations of the islands of Saint-Martin and Saint-Barthélémy, which have been rendered uninhabitable by the hurricane, to Guadeloupe.** The evacuation is carried out in the framework of cooperation with the European Union, notably supported by the Netherlands. The police and *gendarmerie* forces of Guadeloupe are fully mobilised in the face of popular demonstrations which break out against a backdrop of panic, while **the FAA receive and settle the repatriated populations in humanitarian emergency camps.** A few hours after the start of operations, **the Institute for Radiological Protection and Nuclear Safety declares that it has detected higher than average levels of radioactivity at a site in Guadeloupe *via* its Teleray monitoring network, which provoked riots.** The mobilisation of the FAA in response to the riots temporarily restricts HADR resources and slows down the evacuation process. On the 18th of July, the French Nuclear Safety Authority (ASN, *Autorité de Sûreté Nucléaire)* makes public the results of its investigation into the measurement of radioactivity levels at 18 sites in the French West Indies. The ambient dose rates measured in Saint-Martin and Saint-Barthélemy are between 1 and 2 µSv/h (microSievert per hour), that is to say 10 to 40 times the level of natural radiation. In Guadeloupe, the dose rate drops to 0.5 µSv/h. No abnormal dose rates are measured in Martinique. **France's financial fragility and the strain on its military capabilities reinforces its choice to cooperate with China**, which sends radiation protection equipment and nuclear experts to the region. A **relationship of strategic and military dependence is established between the two countries**. Finally, **this situation calls into question the strategic advantage that France derives from the excellence of its nuclear industry within the international community, through a national and international mistrust of this technology. This mistrust leads to an immediate moratorium on the use of Small Modular Reactor (SMR) by the armed forces.**

LESSONS LEARNED

Lesson 1: Preventing over-solicitation of the armed forces through regional cooperation

The intensification and diversification of missions in the region require **anticipating the over-solicitation of forces**, which could lead to the prioritisation and discrimination of French strategic interests. A **regional understanding** of associated risks is necessary in view of the transnational nature of climatic hazards, but also of the criminal phenomena they are likely to induce, particularly the increase in seaborne trafficking. It thus seems necessary to **consolidate the cooperation of French armed forces with those of neighbouring islands**, not only **in the event of meteorological and climatic hazards**, but also in a **broader framework of climate-related security operations**.

Proposal 1: Broaden the framework for regional cooperation: from HADR cooperation to climate resilience cooperation

The CARIBBEAN 2022 exercise demonstrated the close cooperation of the French armed forces in the Caribbean with their regional military partners, in the context of the hurricane season and the increase in extreme weather and climate events. Given the **diversity of climate changes manifestations in the region**, it would be relevant to broaden the framework of regional cooperation to a **more comprehensive cooperation on climate resilience.** This would no longer be limited to the management of HADR situations but would encompass **cross-cutting missions related to health, humanitarian and security consequences of chronic climate hazards such as drought and high temperatures**. Such configuration would enable **relying on allied armed forces in the event of exceptional over-solicitation of the French ones.** Such solicitation could for example be due to food distribution to the population, relocation of households affected by rising water levels, or support to civil security forces.

Proposal 2: Enact a French/European reference military camp for piloting multilateral climate resilience operations in the region

In 2017, a coordination point was set up at the Dutch naval base Parera in Curaçao as part of the joint British, French and Dutch Operation Albatros. It would be appropriate to build on this experience to develop a **climate-resilient military base, suitable for hosting foreign forces and for piloting joint climate resilience interventions**. This point of military coordination would also be a **source of influence** in the region, which the increasing and intensifying effects of climate changes should particularly highlight.

Proposal 3: Develop drug control cooperation with insular and Latin American countries

In the **fight against seaborne drug trafficking**, most cooperation channels used by French armed forces are oriented towards Western powers (thus mainly based outside the area) and dominated by a **bilateral relationship with the US**. **Closer cooperation with island states** directly affected by trafficking would be relevant. This could take the form of a **regional programme to support the fight against organised crime,** such as ALORCA[90]. In order to guarantee the effectiveness of such fight, **the French armed forces should also consider closer cooperation with Latin American states,** along the lines of the cooperation between France

[90] A three-year regional cooperation programme set up in 2015 and run from Santo Domingo.

and Colombia[91]. Eventually, **OFAST could benefit from liaison officers from Latin America or small island countries of the Caribbean,** which could, in the long term, **extend the list of signatories of the San José Agreement**[92].

Proposal 4: Improve the identification of French regional support in the fight against IUU fishing

France has a fisheries police service (147 tonnes of fish seized in 2021) to which the French Navy actively contributes along with the French Maritime Affairs, the Gendarmerie Maritime, the Gendarmerie Nationale and Customs. Military vessels dedicated to fighting seaborne trafficking also participate in tracking illegal fishing. As fishing vessels are regularly involved in drug trafficking, it creates a close link and a community of expertise between these two missions. A stronger involvement of the FAA in fisheries control would not only prevent illegal fishing from taking place in the French EEZ, but also position the FAA as instrumental support of CARICOM in this area. The **Caribbean Regional Fisheries Mechanism** (CRFM) and the **Caribbean Community Implementation Agency for Crime and Security** (CARICOM IMPACS) have met on this very topic. The minister of Fisheries of St Vincent and the Grenadines has in fact stated that **he wants to work with regional and international partners in this domain** (Caricom Today, 2022, 24 March; CRFM, 2022, 18 March).

Lesson 2: Strengthen the coordination of the armed forces with civilian actors on an interministerial level

In the face of climate changes, the diversification of the French armed forces' missions in the West Indies blurs the boundaries. It gradually homogenises their field of action with those of civil and internal security. The occurrence of climatic hazards, whether they are one-off or slow-onset, is likely to **push the forces to their capacity limits by exposing them to cross-sectoral challenges**, requiring close interministerial cooperation. Regional environmental security issues cut across a multitude of other institutions, affecting agriculture, health, industry, energy, civil security, international relations, defence, ecology and territorial cohesion. **Strengthening interministerial cooperation and restructuring it around the objective of climate resilience** would relieve the armed forces by allowing them to **take coordinated responsibility for security issues that are not directly defence issues**[93]. Such cooperation on climate issues would be a decisive asset in anticipating the needs for coordination and supplementation of the actors mobilised to respond to the effects of climate changes.

Proposal 1: Appoint a "Caribbean climate response coordinator" officer in the framework of the Joint Territorial Defence Organisation (JTDO)

It would be appropriate to **strengthen cooperation between the stakeholders of the Zone de Défense et de Sécurité (ZDS) and those of the Circonscription militaire de Défense aux Antilles. The first** is primarily under

[91] Bilateral cooperation between France and Colombia is enshrined in the "Col-Fra" agreement (Bray, 2012).
[92] Signed in 2003 by Costa Rica, the Dominican Republic, France, Guatemala, Haiti, Honduras, Nicaragua, the Netherlands and the United States, it gives States Parties the possibility to intervene in the territorial waters of other States Parties for anti-trafficking operations, and even in their internal waters.
[93] See, for example, the crisis management exercises related to energy distribution networks highlighted by France Stratégie (Rais Assa et al., 2022, May).

the authority of the Ministry of the Interior, whereas the second is under the direction of the Ministry of the Armed Forces. This cooperation takes place within the framework of the **Organisation Territoriale Interarmées de Défense (OTIAD)**. More specifically, the **role of the General Officer of the Antilles ZDS**, placed under the authority of the Chief of Staff of the Armed Forces, should be **strengthened** by giving him the **additional function of "climate response coordinator for the Antilles"**. This would enable the effective translation of interministerial cooperation in the Antilles regarding climate issues, and to guarantee the **fluidity of communications between the armed forces and civil security in the zone**.

Proposal 2: Organise an annual 'climate' meeting of the Antilles Defence Zone Joint Committee

The **Antilles Joint Defence Zone Committee**, which is required to meet at least once a year, could set up an **annual meeting to deal with the new climate challenges faced in the zone**. This meeting could be **chaired by the "Antilles climate response coordinator" officer** in order to guarantee the continuity and coherence of actions carried out with the EMIZ. In this context, he could propose reinforced coordination with the EMIZ and the associated internal security conference with the aim of establishing a **joint "civil-military cooperation for climate" cell** in addition to the 4 existing cells[94]. Consequently, joint exercises can be organised to ensure that operational services are well coordinated in the event of a crisis.

Proposal 3: Develop and use the voluntary commitment mechanisms in the Antilles (in particular the Adapted Military Service, SMA) to enforce civil-military cooperation to help the population

Orienting the **action of SMA volunteers towards climate issues** and **civil-military cooperation** would enable local volunteer populations to take action to adapt to climate changes. The integration of these issues would **revitalise the SMA** and attract a new public, with varied interests and skills, while guaranteeing higher employability. This new role, embodied by the SMA, should contribute to strengthening the **trust of local populations in state services and armed forces**.

Proposal 4: Establish a Caribbean Civil Protection Training and Intervention Unit (UIISC)

The Ministry of the Armed Forces, together with the Ministry of the Interior, could work on the **establishment of a Civil Security Instruction and Intervention Unit (UIISC) in the French West Indies**. The UIISCs, which belong to the army's engineering arm, currently exist in Corte, Brignoles and Nogent-le-Rotrou, where they provide civil security services. They have **already intervened several times in the Caribbean region**: earthquake Haiti in 2010; hurricane Matthew and water treatment in Haiti in 2016; hurricanes in various overseas regions, such as Irma in Saint Martin and the West Indies and Maria in 2017; medical interventions with the Elément de Sécurité Civile Rapide d'Intervention Médicale notably in Guadeloupe in 2018. The establishment of a UIISC in the region, **focused on climate-related issues,** could allow for greater operationality as well as effective and rapid support to neighbouring countries. **Nuclear risks** should be dealt with as a priority, as well as **epidemic risks.** This new UIISC could be based on the model of the military

[94] Administrative and secretariat unit; economic defence unit; operations, operational preparation and plans unit; training, regional cooperation and prevention unit.

Bioforce created in 1993 by the Ministry of Defence, the Ministry of Foreign Affairs and the Ministry of Cooperation[95] .

Lesson 3: Diversify and strengthen the military mechanism in the region

The diversity and intensity of operational challenges posed by climate changes in the area make it crucial to apply the principle of **redundancy** - the multiplication of entities with the same function in the system - and the principle of **functional diversity** - ensuring that the same functions can be performed by different entities. The application of these principles could be compromised in the overseas territories, where **the armed forces have been significantly undersized** since the mid-2000s[96] . In the Caribbean, the decrease in staffing is accompanied by an **unequal distribution of personnel** across territories.

Proposal 1: Redefine the number of personnels and their distribution in the area

While the 2008 White Paper foresaw a reduction in the volume of military forces in the overseas departments and collectivities, the **2013 White Paper** indicates a **'significant risk of a capability breakdown that could lead to the state no longer being able to adequately fulfil all of its missions in the overseas territories**' (Folliot et al., 2022, 24 February). The virulence of climate changes in the Caribbean, the concentration of military personnel in Martinique, the physical distance separating the French territories from the zone, and the logistical constraints linked to insularity highlight the risk of not being able to fulfil missions. In this respect, the **reinforcement and more homogeneous distribution of forces in the French territories** would enable them to deal with the simultaneous occurrence of crises in several island territories of the zone, without seeing their operationality compromised.

Proposal 2: Invest in air and satellite capabilities

As the French military presence in the Caribbean is primarily maritime, **naval forces have been considerably expanded** since the 1980s. Modifications of missions, particularly in the face of natural disasters, highlight a **growing need to invest in air forces**. The French Senate (Folliot et al., 2022, 24 February) notes the weakness of air capabilities in the Antilles and proposes to base a **multi-purpose helicopter** (army, gendarmerie, customs, civil security) **in Saint-Martin for the northern islands**, which currently depend on helicopters based in Guadeloupe (the helicopters of the Gendarmerie nationale in Guadeloupe and its air force based in Point-à-Pitre, and the EC 145 of the civil security). The FAA would benefit from expanding its air fleet, which is essential for natural disaster management and the development of **air bridges** in times of crisis. The development of air capabilities could be accompanied by a **specific effort on satellite technologies and drones** for maritime traffic surveillance.

Proposal 3: Ensure resilience of military bases: risk assessment mapping, readjustment work and relocation

[95]Integrated into the Force d'action humanitaire militaire d'intervention rapide (FAHMIR), it carried out four types of intervention: epidemic control, public health assessments, biological and epidemiological surveillance in the face of an influx of refugees, and implementation of mass vaccination campaigns (Boulin et al., 2000).

[96] The number of sovereignty forces fell from 8,700 to 7,150 between 2008 and 2018 (Senate, 2022, 24 February).

Given increased natural risks for **military installations** in the Caribbean, it is essential to set up a **system to regularly assess their viability and resilience. Risk-mapping analyses** can be carried out with the support of the Prefecture of Martinique, the DEAL, the Caisse Centrale de Réassurance/Météo-France and RiskWeatherTech. Those stakeholders already worked on these subjects with the *Dossier départemental des risques majeurs en Martinique* (Prefecture of Martinique, 2014) and the *Etude portant sur l'évolution du risque cyclonique en Outre-mer à l'horizon 2050* (Caisse Centrale de réassurance, 2020). Suchmapping exercices would highlight issues and levels of vulnerability (risk maps). They would also depict the impact of hazards (maps of attainable surfaces) on the basis of **scenarios representative of frequent, average and extreme events** (marine submersion, cyclones, drought and bush fires). **Relocating military camps should be considered for excessively exposed land** overtaking a specific critical vulnerability threshold.

Proposal 4: Develop a regional geopolitical watch

The insular Caribbean region is geopolitically structured by **the rivalry between the United States,** historically present in the area and with a solidly established military force**, and China,** which takes advantage of its **economic power** and some **anti-American** strongholds in the area to create **strategic connections**. This **geostrategic polarisation** exposes Caribbean territories to a risk of tension, if not ideological and military conflicts that could affect France through its presence in the region, but also through its **potential strategic dependence on both powers**. It is also likely to induce some political instability. French forces must therefore be able to **analyse the regional geostrategic situation in detail** in order to best protect French interests. Therefore, the establishment of a **geopolitical watch** aimed at **Sino-American relations in the Caribbean**, as well as relations of both countries with island states of the region, seems essential. It could be accompanied by an **increase in intelligence capabilities**.

CONCLUSION

In the front line of the global climate emergency, the insular Caribbean area presents unique defence and security challenges, closely correlated to the physical and geographical characteristics of its territories. The lattter appear to be amplifying factors and generators of socio-economic fragility. The rise in air temperature along with the rise in water temperature and level **degrade insular ecosystems**, particularly through periods of drought, extreme weather and climate events, and flooding. **Economic health and livelihoods,** largely based on tourism, agriculture and fishing, **depend directly on these ecosystems**. These economies and livelihoods are compromised not only by ecosystem degradation, but also by the **destruction of human facilities** - housing, energy, transport and communications infrastructure, and health facilities - triggered by both slow and intermittent climatic hazards.

Ecosystem and socio-economic disruption result in state weakening. It also presents structural impediments to mitigation and adaptation policy initiatives and capacities, contributing to **growing environmental insecurity** in the region. Low political, demographic and financial weights of Caribbean islands lead them to **expect support from major international powers**, which is likely to increase the fragmentation of regional cooperation. Such cooperation is also compromised by **competition** over natural resources and occupation of territories, as well as by the **bipolarisation of the area, under the influence of the United States and China**.

In this context, climate changes in the Caribbean transform the environment in which French military forces operate, leading to an **increase in the complexity and diversification of their missions**. The fragmentation of the regional space creates a **crisis environment**, with the risk of inter-state tensions or conflicts, particularly between the United States and China. In addition, the **need for intervention in the fight against seaborne trafficking and illegal activities linked to parastatal groups** is expected to intensify. This will add to the necessary a**ssistance to populations in the face of natural, health and industrial disasters.** While highlighting limits of the civil security forces, climate changes in the Caribbean also affect operational capacities of the Armed Forces. Deteriorating weather and climate conditions put **direct pressure on military installations and equipment, but also on the health and performance of soldiers**.

In order to address the diverse effects of climate changes on French armed forces, **three prospective scenarios** have been developed in this brief. They project an **economic crisis coupled with a political crisis questioning government legitimacy and regional cooperation.** This scenario also depicts a consolidating Chinese presence in the area. All those factors lead to the over-solicitation of the French armed forces (Scenario I - trend) or the **escalation of Sino-American tensions**, the **call for NATO's collective defence** against a backdrop of block logic and the **geostrategic isolation of France** due to the paralysis of its armed forces (Scenario II - disruptive). In the third scenario, we explore the occurrence of a **hurricane leading to the nuclear accident** at Turkey Point (Florida) and the **contamination of the entire Caribbean area**, resulting in a socio-political crisis. **France's strategic dependence on China** is then underpinned and criticized, as well as the strategic advantage it derives from its nuclear industry. We were also able to draw three major lessons from this foresight exercise and the analysis that preceded it. Firstly, we highlighted the **need to prevent the over-solicitation of French armed forces and suggested strengthening regional cooperation around the "climate" competence**, through multilateral operations that more strongly include the small island states of the region and the countries of Latin America. Secondly, and in relation to this same competence, we mentioned **the need to strengthen the coordination of the armed forces with civil security actors at the interministerial level**. Finally, we evoked **the need to strengthen and diversify the military mechanism in the region, in order to make it more resilient to tougher climate conditions and increasing environmental insecurity**.

ANNEXES

Annex 1.a: Presentation table of the Caribbean Island States

Caribbean Island States	Area (km²)	Population (thousands) in 2021	GDP (USD million) in 2021	GDP per capita (USD) in 2021	HDI in 2020[97]	Climate Risk Index (CRI) in 2000-2019[98]	Climate Policy Index[99]	Security Threat Index in 2022[100]	Armed Forces (personnel) in 2019
Antigua and Barbuda	440	98,73	1471,13	14900,8	0,778 (78)	64,50 (56)	60,20 (24)	5,1 (89)	+/-250
Bahamas	13 880	396,91	11208,60	28239,4	0,814 (58)	27,67 (6)	61,80 (20)	4,6 (106)	2000
Barbados	430	287,71	4900,80	17033,9	0,814 (58)	135,33 (148)	79,80 (5)	4,1 (120)	1000
Cuba	109 880	11317,50	107352,00*	9477,9*	0,783 (70)	s.d.	61,10 (21)	3,7 (128)	76 000
Dominique	750	72,17	545,62	7560,0	0,742 (94)	33 (11)	68,80 (9)	5,8 (72)	0
Pomegranate	340	113,02	1122,08	9928,6	0,779 (74)	39,67 (24)	65,70 (12)	4,05 (111)	0
Haiti	27 750	11541,68	20944,39	1814,7	0,510 (170)	13,67 (3)	27,90 (143)	6,3 (54)	1000
Jamaica	10 990	2973,46	13638,23	4586,7	0,734 (101)	63,83 (54)	54,10 (33)	6,7 (43)	6000
Puerto Rico	8 870	3263,58	103138,30*	31429,9*	s.d.	7,17 (1)	s.d.	s.d.	8500
Dominican Republic	48 670	10953,71	94243,45	8603,8	0,756 (88)	59,50 (50)	36,50 (104)	5,8 (72)	71000
Saint Lucia	620	184,40	1764,90	9571,0	0,759 (86)	60,33 (51)	64.80 (14)	s.d.	0
Saint Kitts and Nevis	260	53,55	976,15	18230,1	0,779 (74)	116,00 (130)	s.d.	s.d.	300
Saint Vincent and the Grenadines	390	111,27	889,78	7996,6	0,738 (97)	59,17 (48)	61,00 (22)	s.d.	0
Trinidad and Tobago	5 130	1403,37	21391,80	15243,1	0,796 (67)	148,00 (159)	49,30 (53)	7,0 (34)	5000

Sources: *World Bank*; *Germanwatch; Geneva Centre for Security Sector Governance; The Global Economy; United Nations Development Programme (UNDP); Yale Center for Environmental Law & Policy.*

***Figures for the** year 2020.

[97] (Ranked worldwide out of 180 countries).
[98] (Ranked worldwide out of 180 countries).
[99] (Ranked globally out of 180 countries). The Climate Policy Index is part of the Environmental Performance Index criteria determined by the Yale Center for Environmental Law & Policy. The higher the score and rank, the more effective and robust the country's climate policies.
[100] (Ranked globally out of 177 countries).

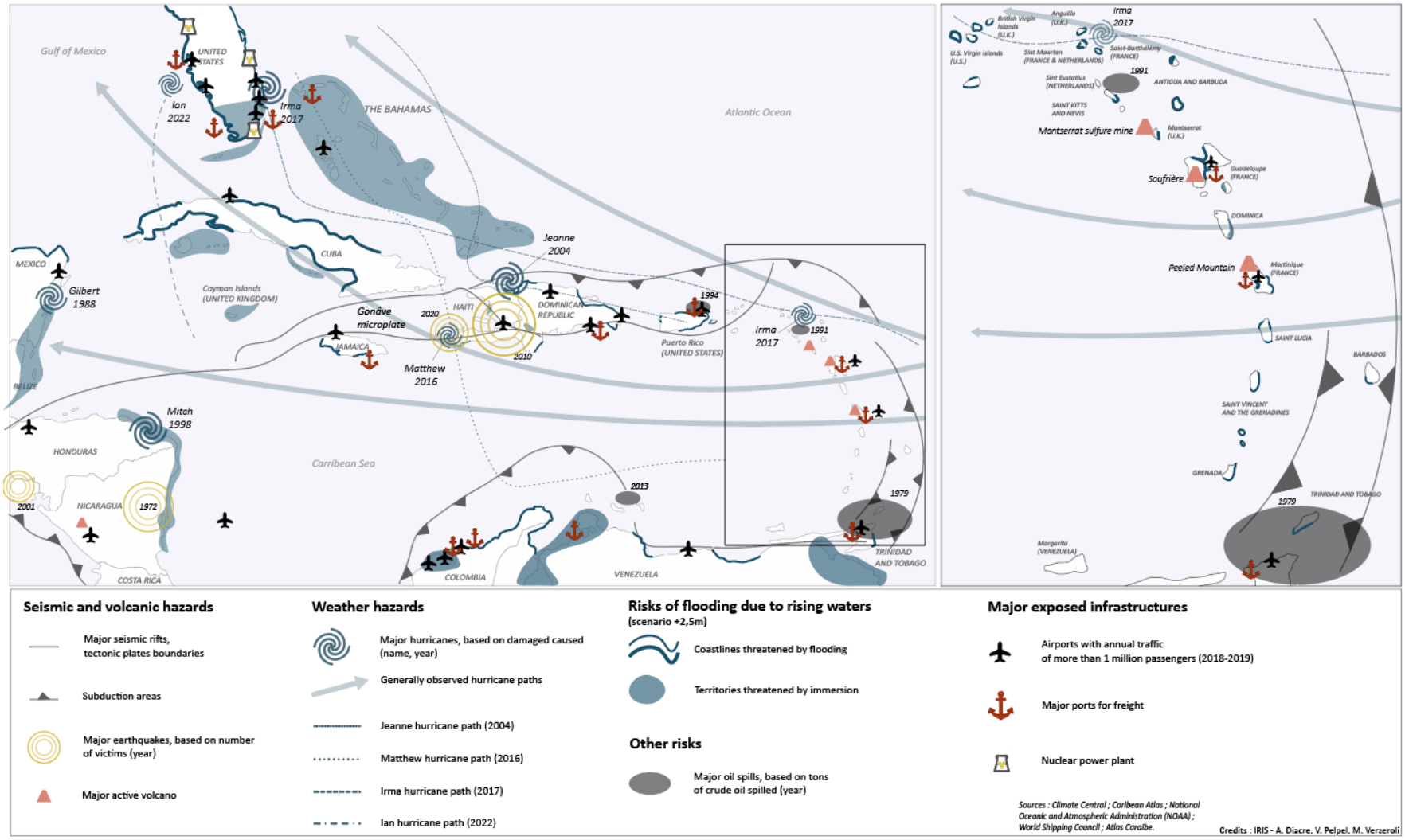
Annex 1.b: Presentation table of the non-sovereign islands of the insular Caribbean

Connecting states	Non-sovereign islands	Status	Area (km²)	Population in 2019 (thousands of inhabitants)	GDP per capita (USD) in 2020	Country Climate Policy Index (CPI) [101]	National armed forces (personnel) in 2019	National forces present in the area
United States	Virgin Islands	Unincorporated and organised territory	350	106,67	39552,2	37,20 (101)	1 388 000	+/-1000
France	Guadeloupe	Overseas Department	1628,4	384,239	25640,64	49,50 (51)	304 000	+/- 1100
	Martinique	Overseas Department	1128,0	364,508	27293,5			
	Saint Barthélemy	Overseas collectivity	25	10,289	s.d.			
	Saint-Martin	Overseas collectivity	53	32,489	s.d.			
Great Britain	Anguilla	Overseas territory	91	14,869	17226	91,50 (2)	149 000	No hold or standing forces in the Caribbean islands.
	Bermuda	Overseas territory	4290	63,91	107706,0			
	Cayman Islands	Overseas territory	264	64,95	85346,8			
	Turks and Caicos Islands	Overseas territory	950	38,19	23879,9			
	British Virgin Islands	Overseas territory	150	30,03	49357			
	Montserrat	Overseas territory	100	4,989	13523			
Netherlands	Aruba	Autonomous state	180	106,31	23384,3	54,50 (32)	41 000	+/-800
	Bonaire	Dutch municipality with special status	294	20,104	23700			
	Curaçao	Autonomous state	444	157,44	16109,9			
	Saba	Dutch municipality with special status	13	1,915	22800			
	Saint-Martin	Autonomous state	34	41,61	28988,3*			
	Saint-Eustache	Dutch municipality with special status	21	3,128	28200			

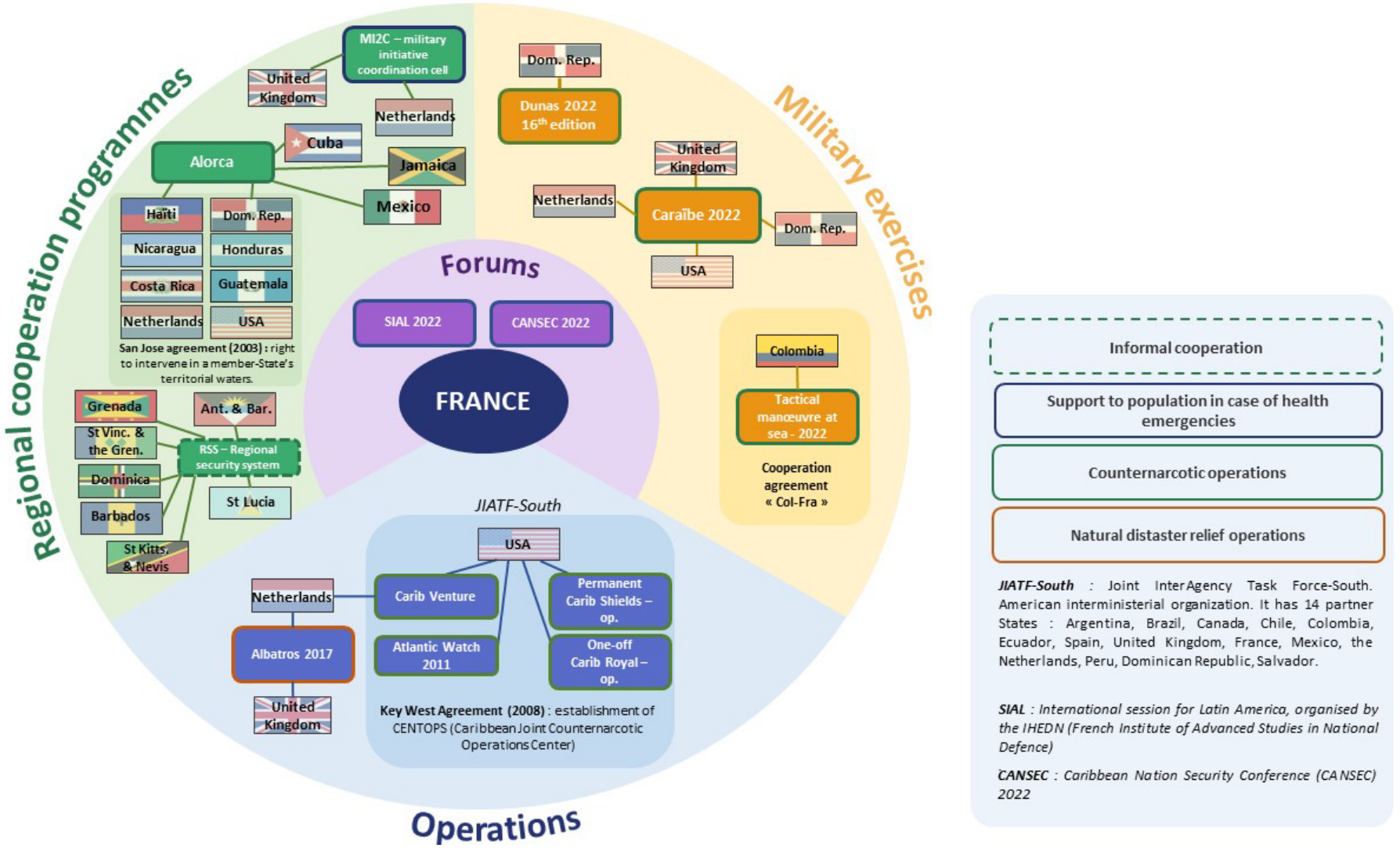
Sources: *World Bank*; *INSEE*; Netherlands Ministry of Defence; *United Nations*; *Overseas Countries and Territories Association (OCTA)*; *Statista Research Department*; *Dutch Central Bureau of Statistics; Senate; Virgin Island National Guard.* ***Figure** for the year 2018.

[101] (Ranked worldwide out of 180 countries).

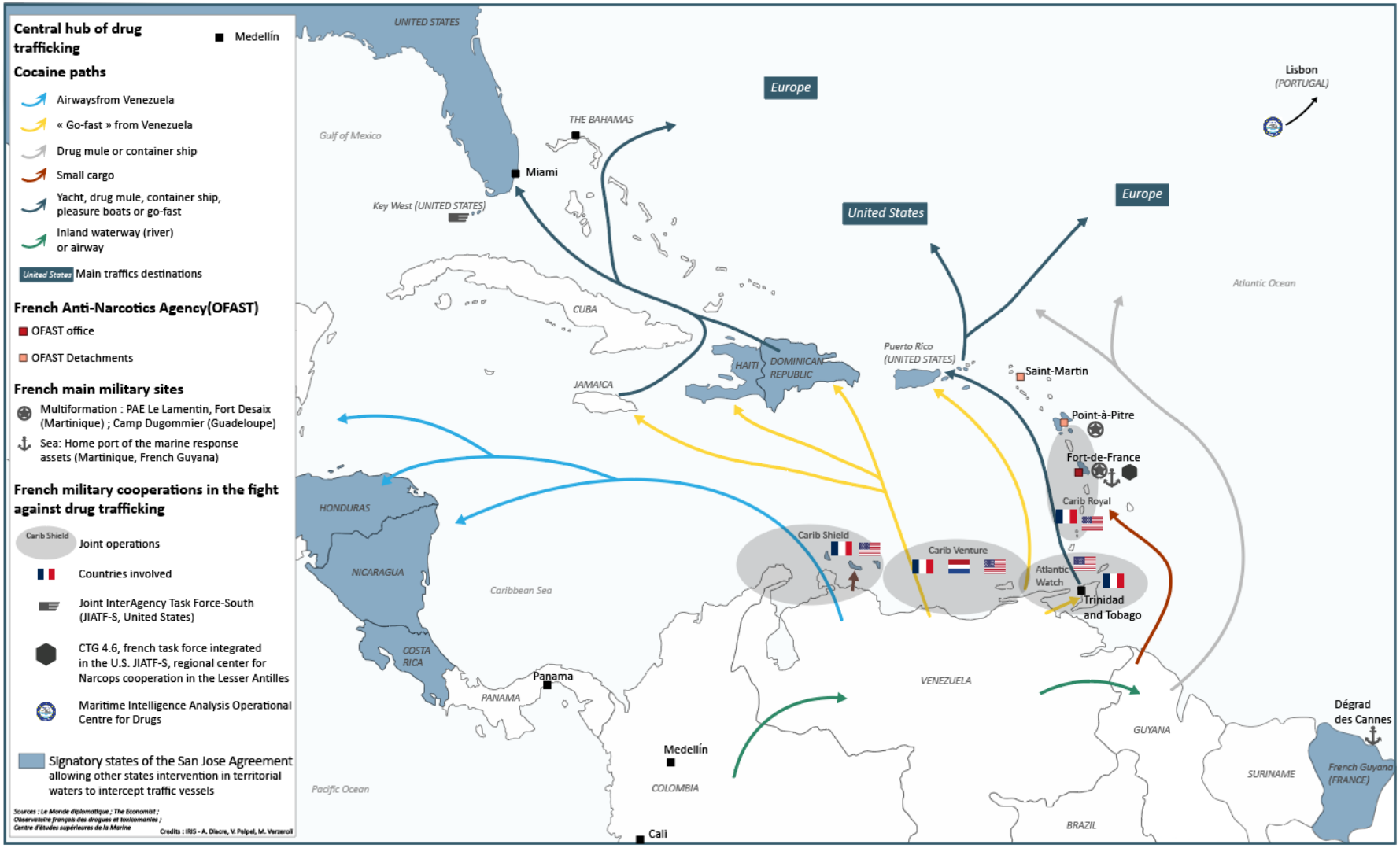
Annex 2: Map of environmental and infrastructural risks in the Caribbean islands



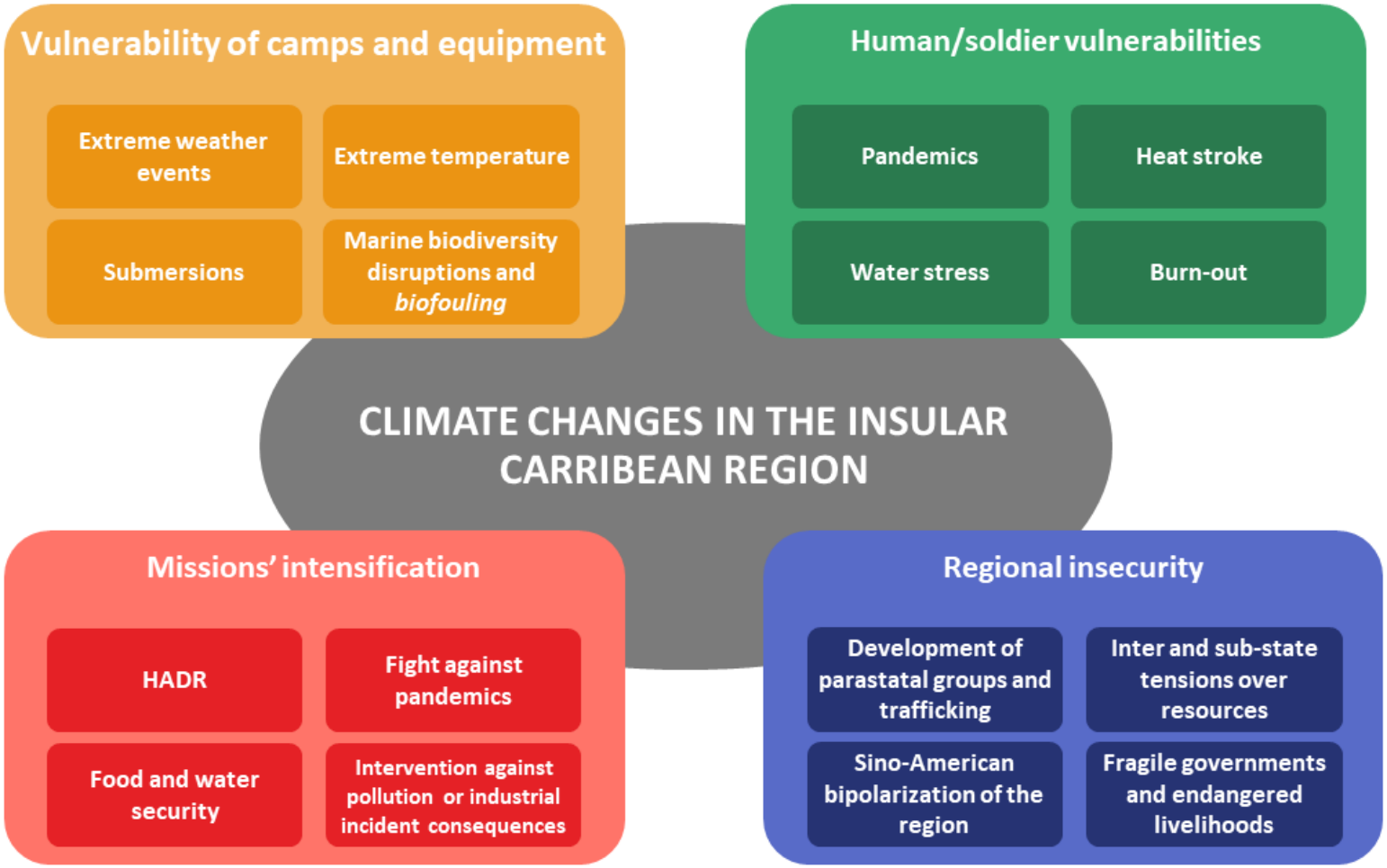
Annex 3: Diagram of the main French military cooperation in the Caribbean islands since the 2000s



Annex 4: Map of drug trafficking in the Caribbean islands



Annex 5: Diagram of the impacts of climate changes on the French armed forces in the island Caribbean



GLOSSARY

Adaptation: process of societal and technical adjustment to climate change in order to mitigate its adverse effects, exploit the beneficial ones, and ultimately ensure the functional integrity of socio-political systems.

Climate changes: variations in the state of the climate observed since the end of the 20th century, attributed directly or indirectly to human activity, modifying the composition of the atmosphere. These variations result in the occurrence of one-off and slow-onset hazards that may have environmental as well as security implications.

Exposure: occurrence possibility of a climatic-environmental hazard in a specific geographical area and for a given period of time.

Fragility (social system): degree to which a social system can be altered directly or indirectly, positively or negatively, by climate change-induced variations. This fragility is social, political and economic and depends on multiple factors: adaptation strategies, level of development, poverty rate, social cohesion, and degrees of economic dependence on an activity, resources, institutions and states.

Food insecurity: a situation in which, according to the FAO, "regular access to sufficient, safe and nutritious food for normal growth and development and an active and healthy life" is not guaranteed (FAO, 2022).

Resilience: elasticity of a system withstanding a disturbance or a hazardous event. It can be reactive or proactive.

Reactive resilience: elasticity of a socio-ecological system withstanding a disturbance or hazardous event allowing it to maintain or return to its state of equilibrium, its structure and its mode of functioning prior to the crisis.

Proactive resilience: elasticity of a socio-ecological system withstanding a disturbance or hazardous event allowing it to maintain and transform itself in a positive and creative way, enabling its sustainability.

Drought: period of abnormally dry weather conditions, long enough to cause serious hydrological imbalances.

Environmental security: state of human security guaranteed by the proactive consideration and minimisation (through adaptation), in defence strategies and security policies, of the anthropogenic threats (degradation) and negative environmental pressures (exposure) on the functional integrity of the biosphere (sensitivity) and its symbiotic human component (fragility), which we are already witnessing and which will increase. The aim is to ensure the resilience of the system.

Human security: the state of preserving and guaranteeing the freedom and ability of individuals to live in dignity, through development, not arms. It encompasses universal and culturally specific elements, both material (resources) and non-material, that are essential for people to act in their own interest and live in dignity.

Sensitivity (ecosystem): Degree to which an ecosystem may be altered directly or indirectly, positively or negatively, by climate change-induced hazards and variations. Sensitivity is particularly dependent on the deterioration of the ecosystem and its environment as a result of human activities.

Water stress: phenomenon of strong tension on the water resources of a territory, occurring when the demand for water exceeds the quantity of water available, or when its poor quality limits its use. This expression is also used to characterise the biological phenomenon whereby the quantity of water transpired by a plant is greater than the quantity of water absorbed.

Vulnerability (climate): Propensity or predisposition to be adversely affected by climate changes (one-off or slow-onset hazards). It depends on the sensitivity of the natural environment, the fragility of the human environment and the adaptation policies implemented.

BIBLIOGRAPHY

Scientific papers

- Alscher, S. (2010). Île d'Hispaniola. Des voisins inégaux confrontés à des défis semblables : dégradation environnementale et migration. *Hommes & migrations*, *1284*, 84-96. https://doi.org/10.4000/hommesmigrations.1248
- Boulin, J. P., Pages, F., Merlin, M., & Baudon, D. (2000). La Bioforce militaire. Principes d'organisation et d'intervention. *Médecine de Catastrophe - urgences collectives*, *3*(1), 21-27. https://doi.org/10.1016/S1279-8479(00)88828-X
- Below, R., Grover-Kopec, E., & Dilley, M. (2007). Documenting Drought-Related Disasters: A Global Reassessment. *The Journal of Environment & Development*, *16*(3), 328-344. https://doi.org/10.1177/1070496507306222
- Buisson, E., Le Stradic, S., Silveira, F. A. O., Durigan, G., Overbeck, G. E., Fidelis, A., Fernandes, G. W., Bond, W. J., Hermann, J.-M., Mahy, G., Alvarado, S. T., Zaloumis, N. P., & Veldman, J. W. (2019). Resilience and restoration of tropical and subtropical grasslands, savannas, and grassy woodlands: Tropical grassland resilience and restoration. *Biological Reviews*, *94*(2), 590-609. https://doi.org/10.1111/brv.12470
- Cashman, A. & Nagdee, M.R. (2017). Impacts of climate change on settlements and infrastructure in the coastal and marine environments of Caribbean small island developing states (SIDS). *Science Review*, *2017*, pp.155-173.
- Chan, K. T. F., Wang, D., Zhang, Y., Wanawong, W., He, M., & Yu, X. (2019). Does strong vertical wind shear certainly lead to the weakening of a tropical cyclone ? *Environmental Research Communications*, *1*(1), 015002. https://doi.org/10.1088/2515-7620/aaecac
- Chandra, S., Lata, H., Khan, I. A., & Elsohly, M. A. (2008). Photosynthetic response of Cannabis sativa L. to variations in photosynthetic photon flux densities, temperature and CO2 conditions. *Physiology and Molecular Biology of Plants*, *14*(4), 299-306.https://doi.org/10.1007/s12298-008-0027-x
- Constant, F. (2021). La Chine dans les Caraïbes : enjeux géopolitiques et leviers d'influence. *Études Caribéennes*, (48). https://doi.org/10.4000/etudescaribeennes.21038
- Daniel, J. (2015). Dossier « Politiques du changement global. Expertises, enjeux d'échelles et frontières de l'action publique environnementale » - La mise en discours et en politique du développement durable dans l'espace caraïbe. *Natures Sciences Sociétés*, *23*(3), 280-288. https://doi.org/10.1051/nss/2015043
- Dobretsov, S., Coutinho, R., Rittschof, D., Salta, M., Ragazzola, F., & Hellio, C. (2019). The oceans are changing: impact of ocean warming and acidification on biofouling communities. *Biofouling*, *35*(5), 585-595. https://doi.org/10.1080/08927014.2019.1624727
- Dubesset, É. (2019). La Chine dans la politique extérieure de Cuba (1959-2019). *Études Caribéennes,* (42). https://doi.org/10.4000/etudescaribeennes.15836
- Dupont, L. (2014). Le changement climatique et ses implications économiques sur le secteur touristique à la Guadeloupe et à la Martinique (Petites Antilles). Études Caribéennes, (26). https://doi.org/10.4000/etudescaribeennes.6750
- Erickson, P., Kljajić, M., & Shelef, N. (2022). Domestic Military Deployments in Response to COVID-19. *Armed Forces & Society*, 0095327X2110728. https://doi.org/10.1177/0095327X211072890
- Eynaud, M., & Racon, P. (2021). La Covid-19 en Guadeloupe : souffrances et résistances. *Perspectives Psy*, *60*(3), 291-300. https://doi.org/10.1051/ppsy/2021603291
- Farrell, D., Trotman, A. and Cox, C. (2011). *Global Assessment Report on Disaster Risk Reduction: Drought Early Warning and Risk Reduction. A Case Study of the Caribbean Drought of 2009-2010*. International Federation of the Red Cross.
- Ferdinand, M. (2018). Subnational climate justice for the French Outre-mer: postcolonial politics and geography of an epistemic shift. *Island Studies Journal*, *13*(1), 119-134. https://doi.org/10.24043/isj.49
- Gallo Ruíz, L. E., & García Urbina, A. G. (2016). *Enfermedad renal crónica asociada a estrés térmico en ladrilleros artesanales del municipio La Paz Centro-León*. León, UNAN Nicaragua.
- Garner, A. J., Kopp, R. E., & Horton, B. P. (2021). Evolving Tropical Cyclone Tracks in the North Atlantic in a Warming Climate. *Earth's Future*, *9*(12). https://doi.org/10.1029/2021EF002326
- Gautam, P.K. (2009, october). Climate Change and the Military. *Journal of Defense Studies*. Vol 3. No 4.

- Gledhill, D. K., Wanninkhof, R., Millero, F. J., & Eakin, M. (2008). Ocean acidification of the Greater Caribbean Region 1996–2006. *Journal of Geophysical Research*, *113*(C10), C10031. https://doi.org/10.1029/2007JC004629
- Gould, W. A., Castro-Prieto, J., & Álvarez-Berríos, N. L. (2020). Climate Change and Biodiversity Conservation in the Caribbean Islands. Dans *Encyclopedia of the World's Biomes* (p. 114-125). Elsevier. https://doi.org/10.1016/B978-0-12-409548-9.12091-3
- Gruber, N., Clement, D., Carter, B., Feely, R., van Heuven, S., & Hoppema, M. et al. (2019). The oceanic sink for anthropogenic CO 2 from 1994 to 2007. *Science*, *363*(6432), 1193-1199. https://doi.org/10.1126/science.aau5153
- Hauser, N., Conlon, K. C., Desai, A., & Kobziar, L. N. (2021). Climate Change and Infections on the Move in North America. *Infection and Drug Resistance*, *Volume 14*, 5711-5723. https://doi.org/10.2147/IDR.S305077
- Herrera, D., & Ault, T. (2017). Insights from a New High-Resolution Drought Atlas for the Caribbean Spanning 1950–2016. *Journal of Climate*, *30*(19), 7801-7825. https://doi.org/10.1175/JCLI-D-16-0838.1
- Hoegh-Guldberg, O. (2011). Coral reef ecosystems and anthropogenic climate change. *Regional Environmental Change*, *11*(1), 215-227. https://doi.org/10.1007/s10113-010-0189-2
- Hoegh-Guldberg, O. (2014). Coral reef sustainability through adaptation: glimmer of hope or persistent mirage? *Current Opinion in Environmental Sustainability*, *7*, 127-133. https://doi.org/10.1016/j.cosust.2014.01.005
- Hungerbühler, S. (2020). Drug Economy and Development in Peru. *MAS in Development and Cooperation*.
- Jeena, G. S., Phukan, U. J., & Shukla, R. K. (2017). Drought-Tolerant Plants. In *Current Developments in Biotechnology and Bioengineering* (p. 101-123). Elsevier. https://doi.org/10.1016/B978-0-444-63661-4.00005-0
- Jenkins, L. M., Alvarez, R., & Jordaan, S. M. (2020). Unmanaged climate risks to spent fuel from U.S. nuclear power plants: The case of sea-level rise. *Energy Policy*, *137*, 111106. https://doi.org/10.1016/j.enpol.2019.111106
- Kaiser, J. (2003). Drought Portends Mosquito Misery. *Science*, *301*(5635), 904-904. https://doi.org/10.1126/science.301.5635.904b
- Kjellstrom, T., Briggs, D., Freyberg, C., Lemke, B., Otto, M., & Hyatt, O. (2016). Heat, Human Performance, and Occupational Health: A Key Issue for the Assessment of Global Climate Change Impacts. *Annual Review of Public Health*, *37*(1), 97-112. https://doi.org/10.1146/annurev-publhealth-032315-021740
- Kjellstrom, T., Holmer, I., & Lemke, B. (2009). Workplace heat stress, health and productivity – an increasing challenge for low and middle-income countries during climate change. *Global Health Action*, *2*(1), 2047. https://doi.org/10.3402/gha.v2i0.2047
- Klöck, C. (2021). Négocier au sein des négociations : les petits États insulaires, l'Alliance des petits États insulaires et les négociations climatiques. *Négociations*, *n°34*(2), 17-31. https://doi.org/10.3917/neg.034.0017
- Knutson, T. R., Sirutis, J. J., Bender, M. A., Tuleya, R. E., & Schenkel, B. A. (2022). Dynamical downscaling projections of late twenty-first-century U.S. landfalling hurricane activity. *Climatic Change*, *171*(3-4), 28. https://doi.org/10.1007/s10584-022-03346-7
- Langkulsen, U., Vichit-Vadakan, N., & Taptagaporn, S. (2010). Health impact of climate change on occupational health and productivity in Thailand. *Global Health Action*, *3*(1), 5607. https://doi.org/10.3402/gha.v3i0.5607
- Meléndez, M., Salisbury, J., Gledhill, D., Langdon, C., Morell, J. M., Manzello, D., Rodriguez-Abudo, S., Musielewicz, S., & Sutton, A. (2020). Seasonal Variations of Carbonate Chemistry at Two Western Atlantic Coral Reefs. *Journal of Geophysical Research: Oceans*, *125*(8). https://doi.org/10.1029/2020JC016108
- Mowla, W. (2021). The Cycle of Risk: Impact of Climate Change on Security Challenges in the Caribbean. *Research Publications*. https://digitalcommons.fiu.edu/jgi_research/46
- Mycoo, M. (2020). Opportunities for Transforming Informal Settlments in Caribbean Small Island Developing States. *Proceedings of the International Conference on Emerging Trends in Engineering & Technology (IConETech-2020)*, 652-662. https://doi.org/10.47412/BHCK8814
- Ouyang, D., Chen, M., Huang, Q., Weng, J., Wang, Z., & Wang, J. (2019). A Review on the Thermal Hazards of the Lithium-Ion Battery and the Corresponding Countermeasures. *Applied Sciences*, *9*(12), 2483. https://doi.org/10.3390/app9122483
- Palanisamy, H., Becker, M., Meyssignac, B., Henry, O., & Cazenave, A. (2012). Regional sea level change and variability in the Caribbean Sea since 1950. *Journal of Geodetic Science*, 2(2). https://doi.org/10.2478/v10156-011-0029-4

- Paranti, C. (2015). Flower of war. *The SAIS Review of International Affairs.* Winter-Spring, Vol. 35, No. 1 (Winter-Spring 2015), pp. 183-200. https://www.jstor.org/stable/27000986
- Petzold, J., & Magnan, A. K. (2019). Climate change: thinking small islands beyond Small Island Developing States (SIDS). *Climatic Change*, *152*(1), 145-165. https://doi.org/10.1007/s10584-018-2363-3
- Reguero, B. G., Losada, I. J., & Méndez, F. J. (2019). A recent increase in global wave power as a consequence of oceanic warming. *Nature Communications*, *10*(1), 205. https://doi.org/10.1038/s41467-018-08066-0
- Resiere, D., Mehdaoui, H., Florentin, J., Gueye, P., Lebrun, T., Blateau, A., Viguier, J., Valentino, R., Brouste, Y., Kallel, H., Megarbane, B., Cabie, A., Banydeen, R., & Neviere, R. (2021). Sargassum seaweed health menace in the Caribbean: clinical characteristics of a population exposed to hydrogen sulfide during the 2018 massive stranding. *Clinical Toxicology*, *59*(3), pp. 215-223. https://doi.org/10.1080/15563650.2020.1789162
- Robinson, S. (2018). Climate change adaptation in small island developing states: Insights and lessons from a meta-paradigmatic study. *Environmental Science & Policy*, *85*, pp.172-181. https://doi.org/10.1016/j.envsci.2018.03.030
- Rury, P. M. (1981). Systematic anatomy of Erythroxylum P. Browne: Practical and evolutionary implications for the cultivated cocas. *Journal of Ethnopharmacology*, *3*(2-3), pp. 229-263. https://doi.org/10.1016/0378-8741(81)90056-8
- Scobie, M. (2016). Policy coherence in climate governance in Caribbean Small Island Developing States. *Environmental Science & Policy*, *58*, pp. 16-28. https://doi.org/10.1016/j.envsci.2015.12.008
- van Tussenbroek, B. I., Hernández Arana, H. A., Rodríguez-Martínez, R. E., Espinoza-Avalos, J., Canizales-Flores, H. M., González-Godoy, C. E., Barba-Santos, M. G., Vega-Zepeda, A., & Collado-Vides, L. (2017). Severe impacts of brown tides caused by Sargassum spp. on near-shore Caribbean seagrass communities. *Marine Pollution Bulletin*, *122*(1-2), 272-281. https://doi.org/10.1016/j.marpolbul.2017.06.057
- Vietti, F., & Scribner, T. (2013). Human Insecurity: Understanding International Migration from a Human Security Perspective. *Journal on Migration and Human Security*, *1*(1), 17-31. https://doi.org/10.1177/233150241300100102
- Wei, J., Jin, Q., Yang, Z.-L., & Dirmeyer, P. A. (2016). Role of ocean evaporation in California droughts and floods: OCEAN EVAPORATION AND CALIFORNIA DROUGHT. *Geophysical Research Letters*, *43*(12), 6554-6562. https://doi.org/10.1002/2016GL069386
- Weisz Argomedo, D. (2020). Climate Change, Drug Traffickers and La Sierra Tarahumara. *Journal of Strategic Security*, *13*(4), 81-95. https://doi.org/10.5038/1944-0472.13.4.1813
- Williams, D., Rosendo, S., Sadasing, O., & Celliers, L. (2020). Identifying local governance capacity needs for implementing climate change adaptation in Mauritius. *Climate Policy*, *20*(5), 548-562. https://doi.org/10.1080/14693062.2020.1745743
- Woodroffe, C. D. (2008). Reef-island topography and the vulnerability of atolls to sea-level rise. *Global and Planetary Change*, *62*(1-2), 77-96. https://doi.org/10.1016/j.gloplacha.2007.11.001
- Yesudian, A. N., & Dawson, R. J. (2021). Global analysis of sea level rise risk to airports. *Climate Risk Management*, *31*, 100266. https://doi.org/10.1016/j.crm.2020.100266
- Yıldırım, U. M., Demircan, M., Özdemir, A. F. & Sarıhan, E.O. (2016). Effect of climate change on poppy (Papaver somniferum L.) production area. *Journal of Field Crops Central Research Institute*, 25 (Special issue-2): 289-295
- Yvars, B. (2019). L'insertion de la Caraïbe dans la mondialisation par une politique pragmatique de pôles de compétitivité. *Études caribéennes*, *43-44*. https://doi.org/10.4000/etudescaribeennes.16729
- Ziska, L. H., Panicker, S., & Wojno, H. L. (2008). Recent and projected increases in atmospheric carbon dioxide and the potential impacts on growth and alkaloid production in wild poppy (Papaver setigerum DC.). *Climatic Change*, *91*(3-4), 395-403. https://doi.org/10.1007/s10584-008-9418-9

Reports

- Bray, R. (2012*). La lutte contre le narcotrafic en mer des Caraïbes*. Centre d'Etudes Supérieures de la Marine.
- ECLAC. (2017). Sustainable development goals implementation in the Caribbean. *FOCUS Magazine of the Caribbean Development and Cooperation Committee (3).*
- Christensen, J.H., Hewitson, B., Busuioc, A., Chen, A., Gao, X., Held, I., Jones, R., Kolli, R.K., Kwon, W.-T., Laprise, R., Magaña Rueda, V., Mearns, L., Menéndez, C.G., Räisänen, J., Rinke, A., Sarr, A. & Whetton, P. (2007). Regional Climate Projections. Dans Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor M., & Miller, H.L. (Eds.). *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth*

Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, New York, 2007.

- Crumpler, K., Gagliardi, G., Meybeck, A., Federici, S., Lieuw, T., Bloise, M., Slivinska, V., Buto, O., Salvatore, M., Holmes, I., Wolf, J. & Bernoux, M. (2020). *Regional analysis of the nationally determined contributions in the Caribbean - Gaps and opportunities in the agriculture and land use sectors*. Environment and Natural Resources Management Working Papers No. 80. FAO.
- Eckstein, D., Künzel, V, & Schäfer, L. (2021). *Global Climate Risk Index 2021 Who Suffers Most From Extreme Weather Events? Weather-related Loss Events in 2019 and 2000 to 2019*. Germanwatch Nord-Süd Initiative e.V
- FAO. (2014). *The CELAC plan for food and nutrition security and the eradication of hunger 2025.* FAO.
- FAO, IFAD, WHO, WFP & UNICEF. (2021). *Transforming food systems for food security, improved nutrition and affordabel healthy diets for all*. FAO.
- FAO & CIMH. (2016). *Drought characteristics and management in the Caribbean.* FAO Water Reports.
- IPCC. (2018). Annex I: Glossary. Dans Matthews, J.B.R. (Ed.1). *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.* Cambridge University. pp. 541-562, doi:10.1017/9781009157940.008
- IPCC. (2022). Small Islands. Dans Mycoo, M., Wairiu, M., Campbell, D., Duvat, V., Golbuu, Y., Maharaj, S., Nalau, J., Nunn, P., Pinnegar, J. & Warrick, O. (Eds.).*Climate Change 2022: Impacts, Adaptation, and Vulnerability.* Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V., Okem, A. & Rama, B. (Eds.)]. Cambridge University Press. pp. 2043–2121, doi:10.1017/9781009325844.017
- Joly, P-B. (2010). *La saga du chlordécone aux Antilles françaises*. INRA/Senset IFRIS. https://www.observatoire-eau-martinique.fr/les-outils/atoumo/pdf_frise/saga_chlordecone_antilles_francaises_1968_2008____47_2010_2-web.pdf. Accessed September 14, 2022. Accessed 14 September 2022.
- PAHO. (2019). *Caribbean Action Plan on Health and Climate Change*. PAHO/CDE/19-16.
- Petit, J. & Prudent, G. (2010). *Changement climatique et biodiversité dans l'outre-mer européen*. UICN.
- UICN Comité français, OFB & MNHN. (2020). *La Liste rouge des espèces menacées en France - Chapitres Faune de Martinique*.
- UNDP (United Nations Development Programme). (2020). *Human Development Report 2020: The Next Frontier: Human Development and the Anthropocène.*
- UNFCCC (2020). *Summary of the first NDC updated (2020-2030) Republic of Cuba*.
- UNFCCC (2020, june). *Update of Nationally Determined Contribution (NDC) of Jamaica.*
- UNFCCC & RCC St. George's. (2020). *NDC Survey Report Caribbean region*.
- WMO. (2020). *WMO Statement on the State of the Global Climate in 2019.* WMO-No.1248.
- Impact Consultancy Services Inc. (2002). *Water and Climate Change in the Caribbean*.
- WHO. (2020). *Antigua and Barbuda Health & Climate Change Country Profile 2020 Small Island Developing States Initiative*. World Health Organization & United Nations Framework Convention on Climate Change. WHO/HEP/ECH/CCH/20.01.06f
- Rais Assa, C., Faure., A. & Gérardin, M. (2022, may). *Risques Climatiques, réseaux et interdépendances : le temps d'agir*. La note d'analyse n°108. France Stratégie.
- Smith, K.R., Woodward, A., Campbell-Lendrum, D., Chadee, D.D., Honda, Y., Liu, Q., Olwoch, J.M., Revich, B. & Sauerborn, R. (2014). Human health: impacts, adaptation, and co-benefits. Dans Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R. & White, L.L. (Eds.) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 709-754.
- Wolf, M. J., Emerson, J. W., Esty, D. C., de Sherbinin, A., Wendling, Z. A., et al. (2022). *2022 Environmental Performance Index*. New Haven, CT: Yale Center for Environmental Law & Policy.

Press and Magazines

- AFP. (August 15, 2021). Covid-19 : l'armée envoie de l'oxygène médical aux Antilles. *L'express.* https://www.lexpress.fr/actualites/1/actualite/covid-19-l-armee-envoie-de-l-oxygene-medical-aux-antilles_2156688.html. Accessed September 5, 2022.
- Caribbean Regional Fisheries Mechanism (March 18, 2022). *CRFM and CARICOM IMPACS partner with Norway to fortify the region's response to fisheries crimes*. Press Release. https://caricomimpacs.org/wp-content/uploads/2022/04/Press-Release-Region-fortifies-response-to-fisheries-crimes.pdf. Accessed October 27, 2022.Caricom Today (March 24, 2022).

- *CRFM, CARICOM IMPACS partner with Norway to fortify Region's response to fisheries crimes*. Caricom Today. https://today.caricom.org/2022/03/22/crfm-caricom-impacs-partner-with-norway-to-fortify-regions-response-to-fisheries-crimes/. Accessed October 27, 2022.
- Cruse, R. (2022). Le Kaléidoscope antillais. *Le Monde diplomatique*. https://www.monde-diplomatique.fr/2022/01/CRUSE/64191. Accessed September 7, 2022.. Accessed 7 September 2022.
- France-Antilles Martinique. (March 4, 2021). Deux nouveaux câbles sous-marins en 2022. *France-Antilles Martinique.* https://www.martinique.franceantilles.fr/actualite/economie/deux-nouveaux-cables-sous-marins-en-2022-573032.php. Accessed July 29, 2022.
- Gomez, M. (October 4, 2022). Cuba demande l'aide des États-Unis après que l'ouragan mortel Ian a coupé l'électricité : Rapport. *The inquirer.* https://theinquirer.fr/cuba-demande-laide-des-États-unis-apres-que-louragan-mortel-ian-a-coupe-lelectricite-rapport/. Accessed October 24, 2022.
- Guilon, Y. & Lorand, K. (May 25, 2022). Le manque de pluie pèse toujours sur l'approvisionnement en eau de la Martinique. *RCI*. https://www.rci.fm/martinique/infos/Environnement/Le-manque-de-pluie-pese-toujours-sur-lapprovisionnement-en-eau-de-la-Martinique. Accessed August 6,2022.
- La crise de l'eau en Guadeloupe, un vieux problème. *L'INA éclaire l'actu*. https://www.ina.fr/ina-eclaire-actu/la-crise-de-l-eau-en-guadeloupe-un-vieux-debat. Accessed September 7, 2022.
- Julien, P. (April 4, 2022). Coronavirus : l'armée à la rescousse des Antilles, un million de masques envoyés. *RTL*. https://www.rtl.fr/actu/debats-societe/coronavirus-l-armee-a-la-rescousse-des-antilles-un-million-de-masques-envoyes-7800359567. Accessed September 5, 2022.
- Lazarus, L. & Ellis, E. (August 3, 2021). How China helps the Cuban Regime Stay Afloat and Shut Down Protests. *The Diplomat.* https://thediplomat.com/2021/08/how-china-helps-the-cuban-regime-stay-afloat-and-shut-down-protests/. Accessed August 7, 2022.
- Le Monde & AFP. (August 23, 2021). L'armée mobilisée face à une épidémie de dengue aux Antilles. *Le Monde.* https://www.lemonde.fr/planete/article/2010/08/23/l-armee-mobilisee-face-a-une-epidemie-de-dengue-aux-antilles_1401654_3244.html. Accessed September 5, 2022.
- Le Monde & AFP. (January 21, 2022). A la Guadeloupe, un gendarme blessé par balles lors d'une nouvelle journée de violences. *Le Monde*.https://www.lemonde.fr/societe/article/2022/01/21/a-la-guadeloupe-un-gendarme-blesse-par-balle-lors-d-une-nouvelle-journee-de-violences_6110347_3224.html. Accessed September 7, 2022.
- Le Monde & AFP. (February 1, 2022). Manifestation du 11 juillet à Cuba : ouverture d'un procès pour sédition contre 33 participants. *Le Monde*. https://www.lemonde.fr/international/article/2022/02/01/manifestation-du-11-juillet-a-cuba-ouverture-d-un-proces-pour-sedition-contre-33-participants_6111812_3210.html. Accessed August 2, 2022.
- Le Monde & AFP. (February 21, 2022). La République dominicaine entame un mur à sa frontière avec Haïti. *Le Monde*. https://www.lemonde.fr/international/article/2022/02/21/la-republique-dominicaine-entame-la-construction-d-un-mur-a-sa-frontiere-avec-haiti_6114551_3210.html. Accessed September 7, 2022.
- Le Point & AFP. (November 19, 2021). Mobilisation contre le pass sanitaire en Guadeloupe : couvre-feu immédiat. *Le Point.* https://www.lepoint.fr/societe/guadeloupe-face-aux-emeutes-instauration-d-un-couvre-feu-19-11-2021-2452885_23.php. Accessed September 7, 2022.
- Lecas, M. (February 5, 2021). En Guadeloupe l'incessante lutte contre la drogue. *Ouest-France.* https://www.ouest-france.fr/region-guadeloupe/departement-de-guadeloupe/en-guadeloupe-l-incessante-lutte-contre-la-drogue-7144634. Accessed August 3, 2022.
- Nixon, A.,V. (September, 2019). « When the Apocalyspe is Now: Climate crisis, Small Island States Disasters and Migration in the aftermath of Dorian », *Stabroek News*. https://www.stabroeknews.com/2019/09/09/features/in-the-diaspora/when-the-apocalypse-is-now-climate-crisis-small-island-disasters-and-migration-in-the-aftermath-of-hurricane-dorian/. Accessed September 12, 2022.
- Regaud, N. (2022). Les armées doivent se préparer aux conséquences du changement climatique. *Esprit Défense n°4|été 2022*. La Délégation à l'information et à la communication de la Défense.
- Rfi. (August 1, 2022). Face aux coupures de courants à Cuba, La Havane rationne son électricité. *Rfi*. https://www.rfi.fr/fr/am%C3%A9riques/20220801-face-aux-coupures-de-courant-%C3%A0-cuba-la-havane-rationne-son-%C3%A9lectricit%C3%A9 . Accessed August 5, 2022.
- Schneider, E. (July 4, 2022). Les Caraïbes se trouvent en première ligne de l'urgence climatique mondiale, selon le chef de l'ONU. *UN News*. https://news.un.org/fr/story/2022/07/1123072#:~:text=D%C3%A9veloppement%20durable%20(ODD)-,Les%20Cara%C3%AFbes%20se%20trouvent%20en%20premi%C3%A8re%20ligne%20de%20l'urgence,le%20chef%20de%20l'ONU&text=Le%20Secr%C3%A9taire%20g%C3%A9n%C3%A9ral%20de%20l,le%20centre%2Douest%20du%20Suriname
- Stanley, B. (June 28, 2021). US Military Destabilised by Climate Change in the Middle East. *Orient XXI*. https://orientxxi.info/magazine/us-military-destabilised-by-climate-change-in-the-middle-east,4885. Accessed September 5, 2022.
- Thomaz, D. (May, 2013). Post-disaster Haitian migration. *States of Fragility*. Forced Migration Review FMR 43. https://www.fmreview.org/fragilestates/thomaz. Accessed October 4,2022.

Web pages

- *Anguilla*. (2022). UN data. https://data.un.org/CountryProfile.aspx/ Docs/CountryProfile.aspx?crName=Anguilla.Accessed September 30, 2022.
- *Armed Forces Personnel, total*. (2022). World Bank. https://data.worldbank.org/indicator/MS.MIL.TOTL.P1. Accessed September 23, 2022.
- World Bank (2021). *Employment in agriculture (% of total employment)*. World Development Indicators. International Labour Organization, ILOSTAT database. https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS Accessed August 10, 2022.
- World Bank. (2022). *The World Bank in Haïti*. The World Bank. https://www.worldbank.org/en/country/haiti/overview. Accessed September 14, 2022.
- *Bonaire*. (n.d.) Overseas Countries and Territories Association. https://www.overseas-association.eu/oct/bonaire/. Accessed September 30, 2022.
- *« Caraïbes 2022 » : dix aéronefs français et étrangers déployés aux Antilles*. (June 8, 2022). Armée de l'Air et de l'Espace. http://air.defense.gouv.fr/actualite/Caraibes_2022_dix_aeronefs_francais_et_etrangers_deployes_aux_Antilles. Accessed September 2, 2022.. Accessed 2 September 2022.
- Caribbean Insight (2019). *Regional division emerge after Trump meets with five Caribbean leaders*. The Caribbean Council. https://www.caribbean-council.org/regional-divisions-emerge-trump-meets-five-caribbean-leaders/. Accessed August 19, 2022.
- *Caribbean Netherlands; gross domestic product (GDP) per capita*. (September 29, 2022). CBS (Statistics Netherlands). https://www.cbs.nl/en-gb/figures/detail/85251ENG. Accessed October 13, 2022.
- Commissariat général au développement durable. (September 10, 2022). *Densité de population des communes littorales en 2016 et évolution depuis 1962*. notre-gouvernement.gouv.fr. https://notre-environnement.gouv.fr/rapport-sur-l-etat-de-l-environnement/themes-ree/milieux-et-territoires-a-enjeux/mer-et-littoral/economie-et-demographie/article/mer-et-littoral-1?lien-ressource=5177&ancreretour=lireplus. Accessed August 15, 2022.
- DEAL de Guadeloupe. (September 3, 20123). *Risques : relocaliser les personnes et les activités.* https://www.guadeloupe.developpement-durable.gouv.fr/risques-relocaliser-les-personnes-et-les-activites-a781.html. Accessed September 9, 2022.
- Direction Opérations du Ministère des Armées. (March 23, 2022). *FAA - Exercice BLUE HAVEN d'entraînement à la lutte contre la pollution maritime*. Ministère des Armées. https://www.defense.gouv.fr/operations/actualites/faa-exercice-blue-haven-dentrainement-a-lutte-contre-pollution-maritime. Accessed September 20, 2022.
- Direction Générale du Trésor. (May 11, 2018). *Présentation Pays – Antigua-et-Barbuda*. Ministère de l'économie, des finances et de la souveraineté industrielle et numérique. https://www.tresor.economie.gouv.fr/Pays/AG/presentation-pays. Accessed July 29, 2022.
- Direction Générale du Trésor. (May 14, 2018). *Présentation Pays – Bahamas*. Ministère de l'économie, des finances et de la souveraineté industrielle et numérique. https://www.tresor.economie.gouv.fr/Pays/BS/presentation-pays. Accessed July 29, 2022.
- Direction Générale du Trésor. (May 14, 2018). *Présentation Pays – Barbade*. Ministère de l'économie, des finances et de la souveraineté industrielle et numérique. https://www.tresor.economie.gouv.fr/Pays/BB/presentation-pays. Accessed July 29, 2022.
- Direction Générale du Trésor. (May 14, 2018). *Présentation Pays – Dominique.* Ministère de l'économie, des finances et de la souveraineté industrielle et numérique. https://www.tresor.economie.gouv.fr/Pays/DM/presentation-pays. https://www.tresor.economie.gouv.fr/Pays/BB/presentation-paysAccessed July 29, 2022.
- Direction Générale du Trésor. (May 14, 2018). *Présentation Pays – Grenade*. Ministère de l'économie, des finances et de la souveraineté industrielle et numérique. https://www.tresor.economie.gouv.fr/Pays/BB/presentation-paysAccessed July 29, 2022.
- Direction Générale du Trésor. (May 14, 2018). *Présentation Pays – Sainte Lucie*. Ministère de l'économie, des finances et de la souveraineté industrielle et numérique. https://www.tresor.economie.gouv.fr/Pays/LC/presentation-pays. https://www.tresor.economie.gouv.fr/Pays/BB/presentation-paysAccessed July 29, 2022.
- Direction Générale du Trésor. (May 14, 2018). *Présentation Pays – Saint-Kitts-et-Nevis*. Ministère de l'économie, des finances et de la souveraineté industrielle et numérique. https://www.tresor.economie.gouv.fr/Pays/KN/presentation-pays. https://www.tresor.economie.gouv.fr/Pays/BB/presentation-paysAccessed July 29, 2022.
- Direction Générale du Trésor. (May 14, 2018). *Présentation Pays – Saint-Vincent-et-les-Grenadines*. Ministère de l'économie, des finances et de la souveraineté industrielle et numérique.

https://www.tresor.economie.gouv.fr/Pays/VC/presentation-pays.
https://www.tresor.economie.gouv.fr/Pays/BB/presentation-pays.Accessed July 29, 2022.
- Direction Générale du Trésor. (August 27, 2019). *Présentation Pays – Jamaïque*. Ministère de l'économie, des finances et de la souveraineté industrielle et numérique. https://www.tresor.economie.gouv.fr/Pays/JM/presentation-pays. https://www.tresor.economie.gouv.fr/Pays/BB/presentation-paysAccessed July 29, 2022.
- Direction Générale du Trésor. (September 21, 2022). *Indicateurs et conjonctures – République Dominicaine*. Ministère de l'économie, des finances et de la souveraineté industrielle et numérique. https://www.tresor.economie.gouv.fr/Pays/DO/indicateurs-et-conjoncture. https://www.tresor.economie.gouv.fr/Pays/BB/presentation-paysAccessed July 29, 2022.
- FAO. (2022). *La faim et l'insécurité alimentaire*. FAO. https://www.fao.org/hunger/fr/. Accessed August 8, 2022.
- France Diplomatie. (January 21, 2022). *Présentation de Haïti*. France Diplomatie. https://www.diplomatie.gouv.fr/fr/dossiers-pays/haiti/presentation-de-haiti/. Accessed September 14, 2022.
- Green Globe. (2022). *Our Green Globe Members*. Green Globe. https://www.greenglobe.com/green-globe-members. Accessed September 14, 2022
- Guadeloupe.gouv. (January 3, 2022). *Campagne "Déposons les armes".* Les services de l'Etat en Guadeloupe. https://www.guadeloupe.gouv.fr/Politiques-publiques/Prevention-securite-des-personnes-et-des-biens/Securite-publique/Campagnes-securite-des-personnes-et-des-biens/Campagne-Deposons-l'es-armes. Accessed September 1, 2022.
- Insee. (2022). Comparateurs de territoires –France. Statistiques et études. https://www.insee.fr/fr/statistiques/1405599?geo=FRANCE-1. Accessed September 30, 2022.
- Météo France (n.d.). *Les cyclones*. Education – Ressources et outils conçus pour l'enseignement. http://education.meteofrance.fr/dossiers-thematiques/le-fonctionnement-de-l-atmosphere/un-phenomene-extreme-les-cyclones/les-cyclones#. Accessed October 25, 2022.
- Ministry of defense. (n.d.). *Military presence in the Caribbean.* https://english.defensie.nl/topics/national-security/in-the-caribbean. Accessed September 30, 2022.
- *Montserrat*. (n.d.). Worldstat info. http://en.worldstat.info/Central_America_and_the_Caribbean/Montserrat/Land. Accessed September 30, 2022.
- Nedopil Wang, C. (July 5, 2022). Brief: China Belt and Road initiative (BRI) Investment Report H1 2022. *Green Finance and Development Center*. https://greenfdc.org/china-belt-and-road-initiative-bri-investment-report-h1-2022/. Accessed August 8, 2022.
- *Per capita GDP at current prices - US dollars.* (2022, 28th January). UN data. A world of information. http://data.un.org/Data.aspx?q=Anguilla&d=SNAAMA&f=grID%3A101%3BcurrID%3AUSD%3BpcFlag%3A1%3BcrID%3A660. Accessed October 13, 2022. Accessed 13 October 2022.
- *PIB ($ US courants)*. (2022). Banque mondiale. https://donnees.banquemondiale.org/indicator/NY.GDP.MKTP.CD. Accessed September 23 , 2022.
- *PIB par habitant ($ US courants)*. (2022). Banque mondiale. https://donnees.banquemondiale.org/indicator/NY.GDP.PCAP.CD. Accessed September 23, 2022.
- *Population, total*. (2022). Banque mondiale. https://donnees.banquemondiale.org/indicateur/SP.POP.TOTL. Accessed September 23, 2022.
- *Saba.* (n.d.) Overseas Countries and Territories Association. https://www.overseas-association.eu/oct/saba/. Accessed September 30, 2022. Accessed 30 September 2022.
- *Sint Eustatius.* (n.d.) Overseas Countries and Territories Association. https://www.overseas-association.eu/oct/saint-eustatius/. Accessed September 30, 2022.Accessed 30 September 2022.
- *Security threats index – country rankings*. (2022). The Global economy. https://www.theglobaleconomy.com/rankings/security_threats_index/. Accessed September 23, 2022.
- *Superficie (kilomètres carrés)*. (2022). Banque Mondiale. https://donnees.banquemondiale.org/indicator/AG.SRF.TOTL.K2. Accessed September 23, 2022.
- *Virgin Island National Guard*. (n.d.). https://vi.ng.mil/. Accessed September 30, 2022.

Institutional documentation

- Arnel, G., Darnaud, M. & Jasmin, V. (July 14, 2018). *Risques naturels majeurs : urgence déclarée outre-mer*. Rapport d'information Sénat n° 688 (2017-2018) au nom de la Délégation sénatoriale aux outre-mer.
- BRGM. (2011). Surveillance quantitative des masses d'eau souterraine de Guadeloupe - Année 2010. [Dumon, A., Coppo N., et Ducreux L.].
- Caisse centrale de réassurance. (2020). Évolution du risque cyclonique en Outre-mer à horizon 2050.
- Cointat, C & Frimat, B. (April 6, 2011). *Guyane, Martinique, Guadeloupe : L'évolution institutionnelle, une opportunité, pas une solution miracle*. Rapport d'information Sénat n°410 (2010-2011) au nom de la commission des lois constitutionnelles, de législation, du suffrage universel, du Règlement et d'administration générale.

- Comité de bassin Martinique. (2015). *Schéma directeur d'aménagement et de gestion des eaux 2016-2021 : district hydrographique de la Martinique. L'impact du changement climatique dans le domaine de l'eau sur le bassin Martinique*. Direction de l'environnement de l'aménagement et du logement Martinique. Schoelcher.
- Commission d'enquête de l'Assemblée nationale (2019). *Rapport sur l'impact économique, sanitaire et environnemental de l'utilisation du chlordécone et du paraquat comme insecticides agricoles dans les territoires de Guadeloupe et de Martinique, sur les responsabilités publiques et privées dans la prolongation de leur autorisation et évaluant la nécessité et les modalités d'une indemnisation des préjudices des victimes et de ces territoires.* [Benin J.]. Présidence de l'Assemblée nationale le 26 novembre 2019.
- Environmental European Agency. (1999). *Environment in the European Union at the turn of the century*. Environmental assessment report No 2.
- Folliot, P., Petrus, A. & Phinera-Horth, M.-L. (February 24, 2022). *Les outre-mer au cœur de la stratégie maritime nationale*. Rapport d'information Sénat n° 546 (2021-2022) au nom de la délégation sénatoriale aux outre-mer.
- Karam, A. (September 15, 2020). *Mettre fin au trafic de cocaïne en Guyane : l'urgence d'une réponse plus ambitieuse*. Rapport d'information au Sénat, session extraordinaire 2019-2020. N°107.
- Ministère des Armées. (May, 2022). *Stratégie Climat & Défense*. Impression Commissariat des Armées - IR – PG Paris.
- Observatoire national sur les effets du réchauffement climatique (ONERC). (2012). *Les outre-mer face au défi du changement climatique : rapport au Premier ministre et au Parlement*. France and France (eds). La Documentation française.
- Préfecture de la Martinique. (2014). *Dossier départemental des risques majeurs en Martinique (972).*
- Santé Publique France. (2011). *Bulletin de veille sanitaire Antilles-Guyane*, n°. 9-10.
- USDAAF. (2003). Heat stress control and heat casualty management. *Technical bulletin TB MED 507/A*. FPAM 48-152 (I).

Books and book chapters

- Becken, S., & Hay, J. E. (2007). *Tourism and climate change: risks and opportunities*. Channel View Publications.
- Breton, V. (2022). Dérèglements Climatiques. Quelles conséquences sur les engagements opérationnels ? In Regaud, N., Alex, R., et Gemenne F., (Ed.). *La Guerre Chaude. Enjeux stratégiques du changement climatique*. Presse de Sciences Po. pp.35-49.
- Célestine, A. (2010). Chapitre 4 / Action collective et labellisation ethnique : les portoricains de New York : Brooklyn, Manhattan (New york). In *Les politiques de la diversité*. Presses de Sciences Po, pp. 93–111. https://doi.org/10.3917/scpo.texie.2010.01.093
- Engel, R. (2022). Changement Climatique et Défense. Un double défi pour les forces armées européennes. In Regaud, N., Alex, R., et Gemenne F., (Ed.). *La Guerre Chaude. Enjeux stratégiques du changement climatique*. Presse de Sciences Po. pp.239-254.
- Maisonneuve, C. (2022). Opérations d'armement. De l'éco-conception à l'adaptation au changement climatique. In Regaud, N., Alex, R., et Gemenne F., (Ed.). *La Guerre Chaude. Enjeux stratégiques du changement climatique*. Presse de Sciences Po. pp.207-220.
- Nexon, E. & Sénéquier, A. (2022). Impacts sanitaires. Quels enjeux pour les armées ? In Regaud, N., Alex, R., et Gemenne F., (Ed.). *La Guerre Chaude. Enjeux stratégiques du changement climatique*. Presse de Sciences Po. pp.63-74.
- Parc national de la Guadeloupe. (2015). *Faune d'eau douce des Antilles*. Le Gosier (Guadeloupe): PLB éditions (À la découverte de la).
- Perret, H. & Laurent, M. (2022). La politique environnementale du ministère français des Armées. In Regaud, N., Alex, R., et Gemenne F., (Ed.). *La Guerre Chaude. Enjeux stratégiques du changement climatique*. Presse de Sciences Po. pp.189-206.
- Trotz, U., Lindo, S., & Caribbean Community Climate Change Center. (2013). Vulnerability and Resilience Building in Caricom Countries. In Northover, P. (Ed.2), *Globalization Climate change and Rural Resilience in the Caribbean.* Commonweatlh Secretariat pp.24-40.

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