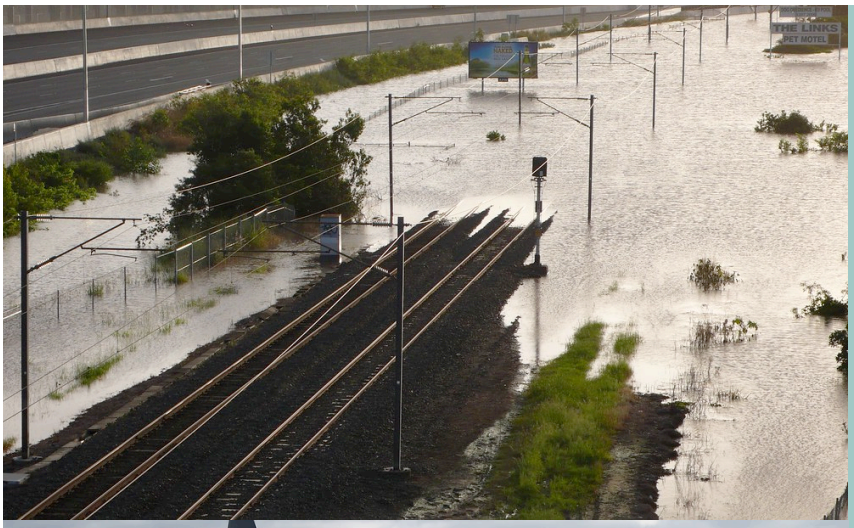

Implications of Climate Change on Defence and Security in the South Pacific by 2030

May 2019

OBSERVATOIRE Défense & Climat

Authors

This report has been prepared by the scientific team of the Observatory on Defence and Climate[1], led by the French Institute of International and Strategic Affairs (IRIS) and financed by the Directorate General for International Relations and Strategy (DGRIS) of the French Ministry of Armed Forces. It has benefited from substantial contributions of representatives of the different SPDMM members.

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[1] https://www.defense.gouv.fr/dgris/recherche-et-prospective/observatoires/observatoire-geopolitique-des-enjeux-des-changements-climatiques

Contents

Introduction

The South Pacific region covers the whole zone of the Pacific Ocean that is located south of the Equator, and comprises hundreds of islands. The South Pacific region will continue to be one of the world's areas that will be most affected by the impacts of climate change. As affirmed by leaders at the 2018 Pacific Islands Forum, in the *Boe Declaration*, "climate change presents the single greatest threat to the livelihood, security and wellbeing of Pacific people" (Pacific Islands Forum Secretariat, 2018). Common climate challenges but also important disparities and strong historical and cultural links between countries of the region have fostered regional cooperation to build resilience to disasters and climate change for decades.

Indeed, the region is characterised by diversity between its different islands: it comprises some of largest islands in the world, but also some of the smallest; countries are at very different levels of development, ranging from least developed countries (Vanuatu, Tuvalu, Solomon islands) to some of the most developed countries in the world (Australia, New Zealand, France). Such differences imply some unequal capacities to address the impacts of climate change and have thus driven the need for regional cooperation allowing mutual assistance and sharing of best practices. Pacific Island countries, however, hold important indigenous knowledge on climate change adaptation. Where this cooperation is already well developed in the South Pacific region, there is still room for improvement in order to better respond to the multiple challenges raised by climate change.

Due to the high number of low-lying atolls, sea-level rise is naturally one of the most pressing concerns. Indeed, one of the most discussed and analysed impacts associated with climate change has been the potential implications of environmental hazards due to sea-level rise on small island states. Projections suggest that the low-lying atolls and islands that are highly dependent on coastal areas for socioeconomic activity are highly vulnerable to sea-level rise (Nurse et al., 2014). The impacts on coastal regions are likely to be exacerbated by an increase in the probability of high-intensity cyclones and associated storm surges. It is also likely that a drying trend across the south-western part of the Pacific would appear if the La Niña phase of the Southern Oscillation becomes more dominant, as projected. This will significantly affect natural resource management in the South Pacific (Preston et al., 2006; Power et al. 2017). Thus, freshwater resources on small islands, many of which are dependent on the positive pressure of freshwater lenses to ensure that salinity does not influence groundwater resources, could also be highly problematic. If more extreme precipitation events come about as projected in places such as Papua New Guinea, local flooding and landslides could become more of a problem. The Food and Agriculture Organization (FAO, 2008) suggests that the combined impacts of climate change, including impacts on local agriculture and fisheries, will significantly increase food insecurity throughout the region.

This report seeks to assess the security implications of climate change in the South Pacific and focuses on four dimensions: the vulnerability of key infrastructure, humanitarian challenges, maritime surveillance and the way forward for regional cooperation. The report was commissioned by the South Pacific Defence Ministers' Meeting (SPDMM) and seeks to guide regional defence forces and ministries to develop concrete recommendations for enhanced cooperation on these issues in the region. The report itself is the result of a cooperation between the Ministries of Defense of Australia, Chile, Fiji, New Zealand, Papua New Guinea

and Tonga, under the coordination of France. The study was coordinated by the French Institute for International and Strategic Affairs (IRIS), and has benefited from valuable contributions of the SPDMM members mentioned above.

A first section draws a broad overview of the expected climate impacts in the South Pacific by 2030, and their consequences for regional security. The report then proceeds to examine the three dimensions that were identified as priorities for cooperation. Each of the three dimensions is first addressed from a regional viewpoint, outlining common challenges. It is then addressed from different national perspective, with a view to sharing best practices and policies. The report concludes with recommendations that aim to increase regional cooperation on the most pressing issues, including some practical steps that could be taken more immediately.

1. Climate impacts in the South Pacific by 2030

The South Pacific region faces significant challenges from climate change, especially rising sea levels, cyclones, droughts, and storm surges. Low-lying atolls and coral islands have drawn global attention due to the potential devastation of small island nations such as Tuvalu and Kiribati. In 2019, Australia experienced its hottest summer, with air temperatures soaring up at 49°C in some regions of the country. By 2030, climate impacts are likely to be exacerbated by the demographic trends in the region, including high population growth – especially in the Melanesia sub-region – and a large number of young people in most populations.

Small island developing states are often considered among the places of the world that are most vulnerable to the impacts of climate change. Many are already experiencing the effects of rising sea levels, higher temperatures, or shifting rainfall patterns (CSIRO et al. 2015). As many authors have pointed out, the impacts of climate change in these territories have often been misrepresented, as they have become symbols of the upcoming climate catastrophe (Barnett & Campbell, 2010; Campbell, 2018; Farbotko, 2010). The adaptive capacities of these territories and their populations have often been overlooked, despite the numerous insights they hold in relation to climate adaptation. However, the magnitude of the expected impacts of climate change poses a serious challenge to those adaptive capacities in coming years. One of the most discussed and analysed impacts in the Pacific has been that of sea-level rise on small island states, which is likely to be exacerbated, in some cases, by fewer but more intense cyclones and associated storm surges that would imply increasing concern about water and food security and coastal protection. Yet other climate impacts are also of great concern for the region – they are summarised in this section, which seeks to brush a landscape of these impacts by 2030.

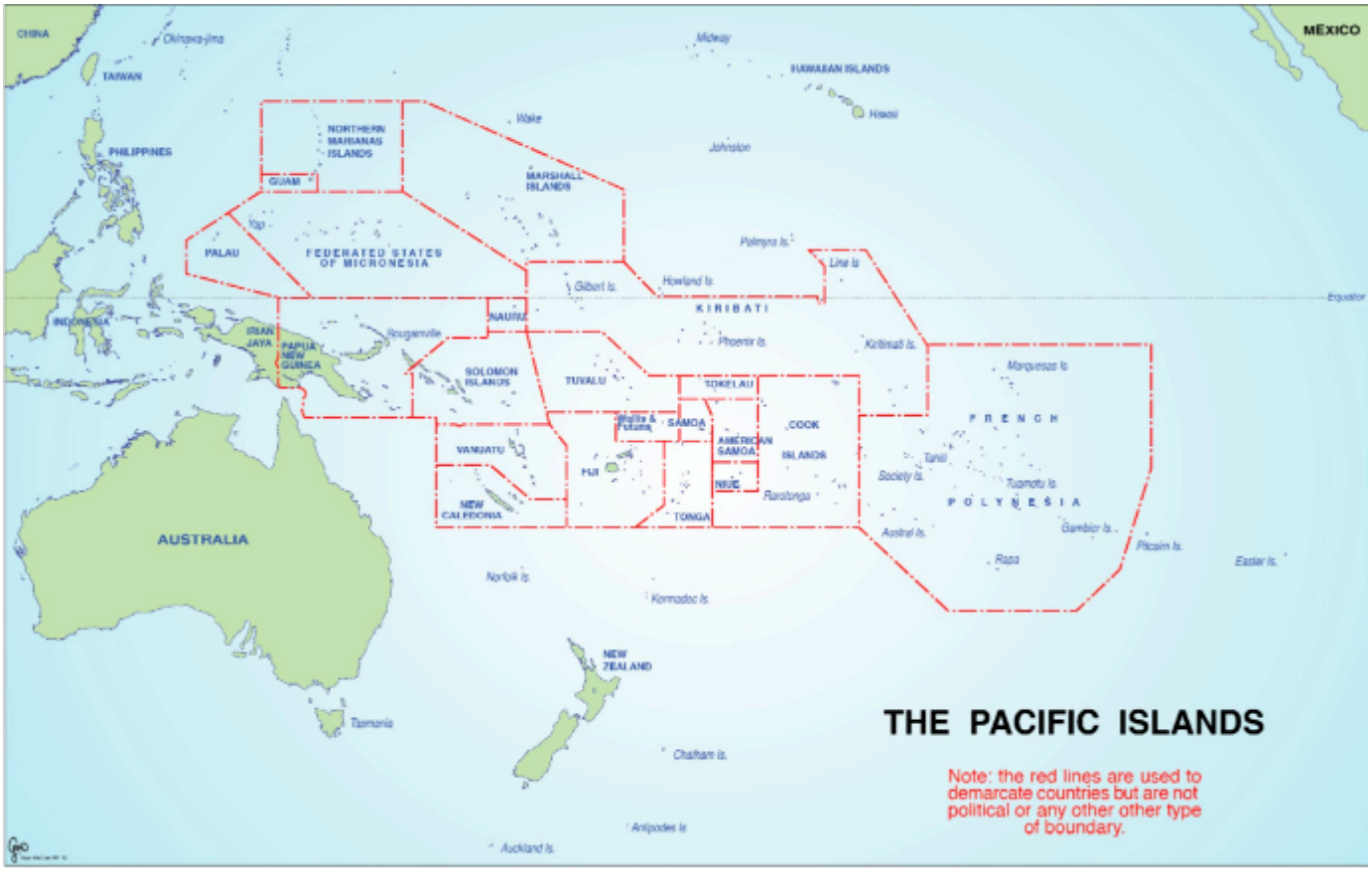

Figure 1 – Map of the Pacific Islands. Source: Campbell 2018.

I. Past and future climate trends

1. Sea-level rise

There are very **significant variations** in the level of oceans across the Pacific region, and such variations can reach up to one meter from one place to another. It is particularly salient around the Equator. Year-to-year variations are also common, and usually average about 20 cm (Hay et al., 2002). The key reason for these year-to-year variations is the El Niño Southern Oscillation (ENSO) phenomenon, which has a major influence on the climate of the Pacific.

Over most of the past century, sea level has risen on average between 1.3 mm and 1.7 mm per year globally, but this rise has accelerated since the end of the 20th century, and the pace is now comprised between 2.8 mm and 3.6 mm per year (Nurse et al. 2014). This rate, however, is deeply uneven across the globe, and there are large regional differences. These differences are of marked concern in the western Pacific and eastern Indian Oceans, where **rates up to four times the global average**, at **about 12 mm per year**, have been reported between 1993 and 2009 (Nursel et al., 2014). As most of the infrastructure in small islands is located on the coast, this is of particular concern.

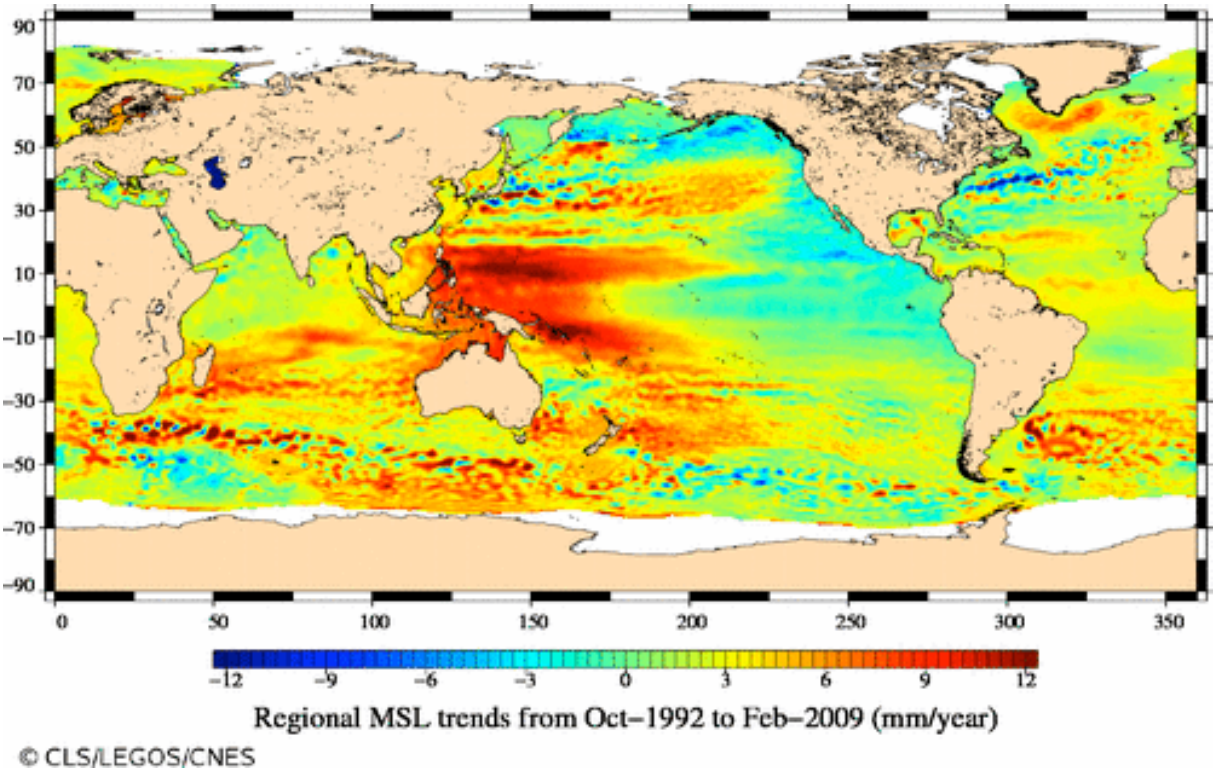

Figure 2 – Map showing regional variations in median seal-level (MSL) rise between 1992 and 2009. Source: Centre National d'Études Spatiales (CNES).

By 2030, sea level will continue to **rise much faster across the Pacific** region than anywhere else, but there will be significant local variations. We can expect, however, that sea-level rise could be up to 10 cm higher than its current level in some locations. Still, recent studies (De Conto & Pollard, 2016) showed that previous projections did not adequately account for the contributions of terrestrial ice and snow from Antarctica, which could – on their own – add an additional 1 metre of sea-level rise by 2100.

Sea-level rise is expected to induce the following consequences, which will be further amplified by increases in sea temperature and acidification, (CSIRO et al., 2015):

- Increased risks of coastal flooding and erosion driving associated damages to critical infrastructure, homes and sites of cultural significance, along with a phenomenon of coastal retreat and beach losses
- Contamination of freshwater aquifers by seawater, leading to an increased salinization of ground freshwater;
- Loss of arable land because of saline incursion;
- Loss of mangroves and other biodiversity reservoirs;
- Relocation of individuals, households, and schools, and potential relocation of larger populations, internally or across international borders.

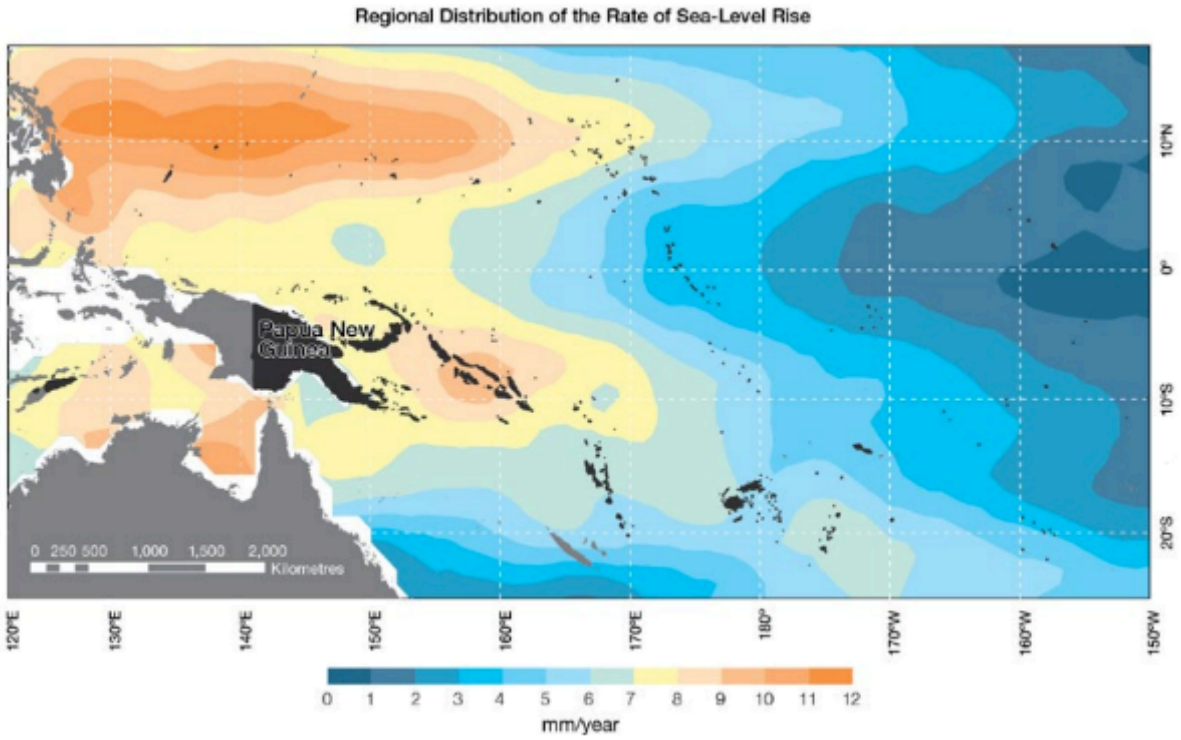

Figure 3 – Regional distribution of the rate of sea-level rise, 1993-2010. ***Source : Australian Bureau of Meterology & CSIRO, 2011.***

Sea-level rise has also fuelled the fear that some islands could be entirely submerged in the future (Nicholls et al., 2011). While this possibility cannot be ruled out, there remain considerable uncertainties not only regarding the future rates of sea-level rise, but also regarding how the geology of island territories will react to this rise (Nurse et al., 2014). But in any event, for local people and communities, a critical fact is whether their land becomes uninhabitable, not just the outcome of submergence.

2. Temperature

The past decade has been the warmest ever recorded in the Pacific (CSIRO et al., 2018), and temperatures are expected to keep rising in the future. Between 1961 and 2017, the average temperature increase has been of 1.0°C in the Pacific. The **highest temperature increase has been recorded in Tahiti** in French Polynesia, with an increase of 1.7°C, while the lowest temperature increase has been recorded at Nadi in Fiji, with an increase of 0.25°C. Overall, it is considered that the warming in Port Moresby (Papua New Guinea) is representative of the mean warming across the region, with a **temperature increase of 0.18°C per decade** (CSIRO et al. 2015). The level of warming is slightly inferior in the north-west Pacific and the subtropical south Pacific.

The number of exceptionally hot days and nights has increased, while the number of cool days and nights has decreased (Campbell, 2018). This is particularly significant as temperature warming is mostly felt by local populations through the increase of the number of hot days (Ferris, Cernea, & Petz, 2011). The **number of exceptionally warm days and nights** is now between 45 and 80 per year, while it used to be around 20 per year: **over the past 50 years, this number has more than tripled** (CSIRO et al., 2015). Not only are hot days becoming

more frequent, but they are also becoming much hotter: the temperature of a 1-in-20-years maximum temperature event has increased by 0.7˚C over the last 60 years (CSIRO et al., 2015).

In the future, temperatures will continue to increase, as well as the number of hot days and nights. According to the latest IPCC Special Report, a global temperature rise of **1.5°C could be reached by 2040** (Allen et al., 2018), which means that one can expect a warming of about 1.3-1.4°C by 2030, compared to pre-industrial levels.

These increased temperatures are expected to yield the following consequences (CSIRO et al., 2015):

- An increase in the intensity and frequency of storm surges and high tides;
- Increased demand for cooling systems and increased transmission loss in electrical wires: for example, electrical black-outs were reported as a result of the 2019 heat wave in Australia;
- Increased risk of bush fires and forest fires;
- Reduced productivity and perturbations in agricultural harvest;
- Migration and loss of fish stocks;
- Significant health impacts: direct mortality and injury due to weather extremes, increased incidence of heat stress, Increased incidences of vector-borne diseases such as malaria, Dengue fever and Chikungunya, compromised health due to lack of access to fresh water and adequate nutrition, and mental health impacts associated with uncertainty and trauma of both acute and slow-onset disasters.
- Higher rate of coral bleaching, with flow-on effects on food security and natural protection of coastal areas;
- Increased number and spread of exotic and invasive species, which impact on food security.

These different impacts will also be compounded by changes in the hydrological cyle, including changes in rainfall patterns that remain difficult to predict.

3. Rainfall

Rainfall is extremely variable, from month to month and from year to year (Nurse et al., 2014). ENSO is another key factor that explains the year-to-year variability, as well as the relative frequency of cyclones. Therefore, it is very difficult to identify strong rainfall trends across the region. It has been possible, however, to identify a small trend in the past decades, from 1981 onwards, which has shown that the **south-west Pacific becomes wetter, and the central Pacific becomes drier** (CSIRO et al., 2015). It is not clear, however, whether this trend can be attributed to climate change, or is rather the effect of ENSO.

In the future, rainfall intensity associated with tropical cyclones is projected to significantly increase (SPC et al., 2016). **Average rainfall is expected to increase** across the Pacific region (CSIRO et al., 2015), with warming resulting in an increasing frequency and intensity of El-Nino events (Power, Delage, Chung, Ye, & Murphy, 2017). This trend would naturally be exacerbated under a high-emissions scenario. The trend for more extreme rainfall events will

become more apparent however and is likely to affect in particular the countries that are located the furthest away from the Equator and that have mountainous areas. By the end of the century, **extreme rainfall events that typically occur once every 20 years are likely to occur once every 7 to 10 years in a low-emissions scenario**, and once every 4 to 6 years in a high-emissions scenario (CSIRO et al., 2015). This trend should already be observable by 2030, even though it will be amplified throughout the century. It is notable that extreme rainfalls are expected to increase even in regions where a decrease in average rainfall is projected.

As a result of these changes in rainfall patterns, the **number of droughts is likely to decrease in most areas** of the Pacific, especially around the Equator. However, countries that are further away from the Equator, and in particular Australia, New Zealand and the Cook Islands, but also Tonga and New Caledonia, are likely to experience an increased frequency and intensity of droughts (Reisinger at al., 2014).

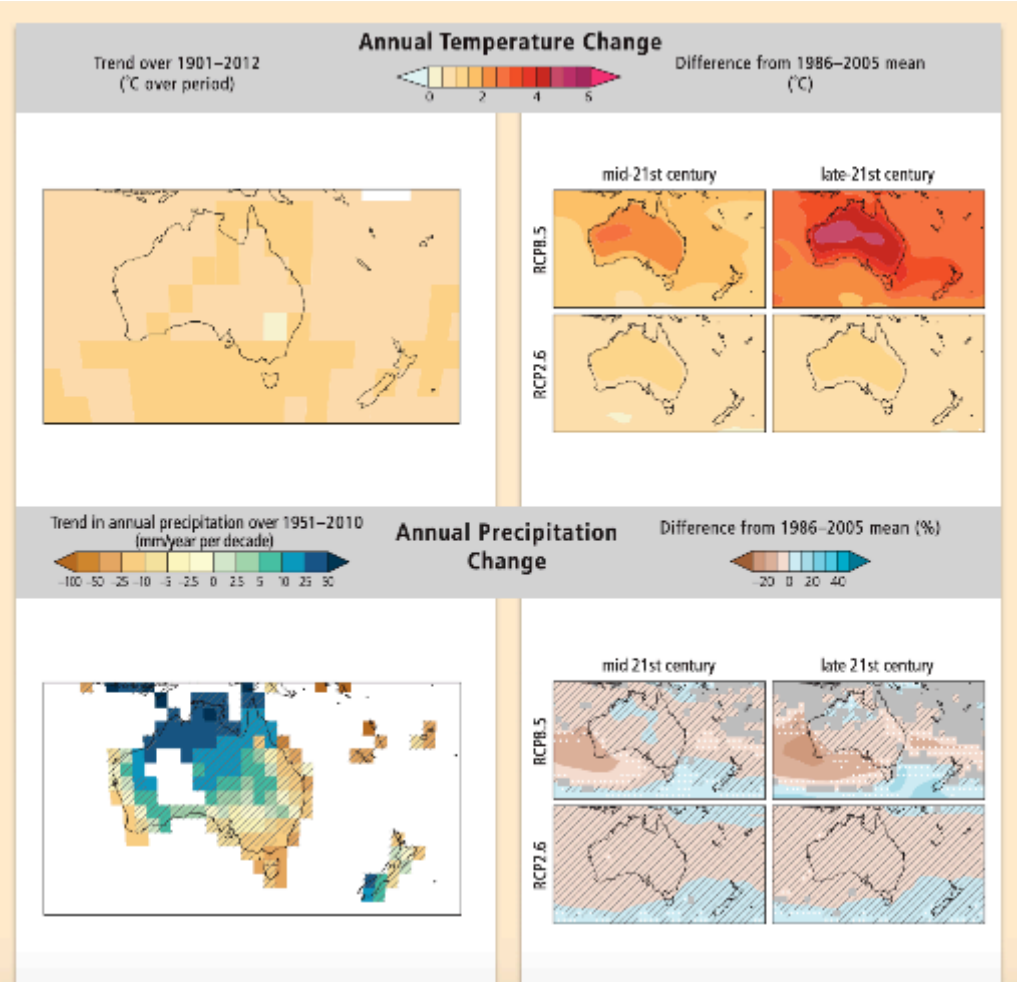

Figure 4 – Projected temperature and precipitation change in the region around Australia and New Zealand. Source: Reisinger et al., 2014.

4. Tropical cyclones

While most of the focus on climate impacts in the Pacific usually centres on sea-level rise, tropical cyclones typically represent the most immediate climate risk to territories and populations of the Pacific (Shen & Gemenne, 2011). Tropical cyclones in the Pacific usually

occur between November and April, in latitudes between 10° and 25°, and are strongly influenced by ENSO. Though there is a year-to-year variability, the Pacific typically experiences **an average of 10 cyclones per season** (CSIRO et al., 2015). In recent years, cyclones Pam (2015), Gita (2018), and Winston (2016) caused very significant damage respectively to Vanuatu, Tonga and Fiji, where tropical cyclone Winston impacted 62 % of the country's population, claimed 44 lives, and damaged 30,000 houses, 500 schools and 90 medical clinics. The damage caused allegedly amounts to two billion dollars, and the cyclone's social and psychological impacts were substantial (Government of the Republic of Fiji et al., 2017).

Though it is yet difficult to identify a strong trend in cyclone activity across the Pacific, climate models suggest that there will be an **increase of cyclonic activity in the Northern Pacific**, and a **decrease of cyclonic activity in the South Pacific** (CSIRO et al. 2015). The intensity of cyclones will also be affected: while there will be less medium-intensity cyclones, models indicate a higher frequency of low-intensity and high-intensity cyclones. This means that, though the average intensity of cyclones is likely to remain stable, many regions of the Pacific are likely to experience **cyclones of higher intensity** (Nurse et al., 2014; Campbell, 2018).

This greater proportion of severe tropical cyclones is likely to induce the following consequences (CSIRO et al., 2015):

- Stronger winds and rainfall, causing significant damage to infrastructure;
- Increased compounding effect of sea-level rise, causing stronger storm surges and coastal inundations;
- Risk of overflown dams in some locations.

II. Overall security implications

Climate change is often labelled as a "risk multiplier" in the Pacific, which can exacerbate state fragility, conflict dynamics or economic vulnerability. And it is also an existential risk for some island states and territories. Over the past few years, climate change has been identified as a major security challenge by numerous governments of the region, including Fiji, France and New Zealand (McPherson, 2017; New Zealand Ministry of Defence, 2018). The recent adoption of the Boe Declaration on Regional Security (Pacific Islands Forum Secretariat, 2018) by the Pacific Islands Forum (PIF) member countries officially reaffirms that "climate change remains the single greatest threat to […] the peoples of the Pacific", and an increased commitment to enhanced regional security cooperation, coordination and analysis.

The security implications of climate change can manifest themselves through a wide range of aspects. This section attempts to elaborate briefly on these different aspects, following the typology put forward by the New Zealand Ministry of Defence (2018), before the report focuses on three aspects of particular interest for regional defence cooperation: the vulnerability of key infrastructure, humanitarian challenges and the surveillance of maritime zones.

1. Human security challenges

The impacts of climate change compromise the livelihoods and human security of many populations. It will increase their exposure to numerous environmental risks such as floods, cyclones and storms, but also to saline contamination of freshwater and vector-borne diseases such as dengue or chikungunya (Barnett & Adger, 2003). McPherson (2017) notes that:

> *"traditional communities in the South Pacific have survived environmental hardships and have a high degree of local resilience. However, climate change could magnify the effects of pre-existing hazards and social problems, exacerbate existing factors causing violence, undermine the resilience of communities and make it more difficult for communities and governments to recover from disasters and resolve issues".*

Indeed, the human security challenges induced by climate change will be determined by underpinning social context. As an example, smallholder farmers across the region are more vulnerable to climate change than urban populations, because the former have land tenure insecurity due to climate change effects and heavily depend on food markets (Barnett, 2001)

Food security is an important component of human security. Many Pacific countries have subsistence economies mainly based on indigenous tree crops (breadfruit, banana, pandanus and coconut) and fishing, particularly tuna which is seasonally abundant and is an important source of incomes and livelihoods (Governement of Kiribati, 2007 ; Government of Tuvalu, 2007). Some islands however are more dependent on imported foods, notably rice and tinned fish. In urban areas, there is an exceptional dependence on imported foods, and a high incidence of non-communicable diseases. In urban areas, **most groundwater is not potable** and this situation will worsen as urban populations grow, as aquifers shrink and as pollution increases. Expensive desalination plants are already being used, but are proving not durable in the hot, humid salt air. In more remote outer islands, there are concerns for subsistence agriculture and food security with the increased risk of seawater infiltration due to storm surges and sea level rise. Warmer oceans will also increase **coral bleaching**, entailing a decrease in the biodiversity and fish population of coral reefs, and associated lagoons, with harmful impacts on food security.

A manifestation of this human insecurity, combined the search for better livelihoods, is evidenced by **migration**. Due to deep genealogical and cultural ties to their land, which is often owned collectively under customary title, many Pacific island people have a strong preference to adapt *in situ* to the impacts of climate change. Therefore, most investments are directed towards supporting and enabling in situ adaptation, and any discussions around migration can be highly sensitive. While recognizing these concerns and priorities, climate change-related migrations are already occurring and are likely to increase over time. Nearly all of this migration is internal, with people moving inland, away from eroding coastlines.

While some governments have explored cross-border migration policies in the past, there is a strong reluctance to being forced from ancestral homelands. Pacific countries' priorities are for polluting states to mitigate emissions urgently and ambitiously, in line with their Paris Agreement commitments, and to provide finance to enable in situ adaptation.

If, however, new areas become uninhabitable and people are forced by the environmental changes to migrate, either within their country or across international borders, there are far-

reaching human rights implications. National, regional and international support will be needed to minimize the risks intrinsic to such relocations, peace-building approaches will be needed to support both migrants and destination communities, and gender-sensitive approaches will be needed to ensure women's empowerment and success, and to avoid exploitation and gender-based violence. This holds true whether the relocation is rapid and undertaken as part of a humanitarian operation, or whether it is planned and in response to slow-onset impacts of climate change.

2. Health-related crises

Between 2010 and 2012, the World Health Organisation conducted a broad assessment of the health impacts of climate change in 13 Pacific countries. They found out that "climate-sensitive health risks in Pacific Islands countries included trauma from extreme weather events, heat-related illnesses, compromised safety and security of water and food, vector-borne diseases, zoonoses, respiratory illnesses, psychosocial troubles, non-communicable diseases, population pressures, and health system deficiencies" (McIver et al., 2016).

Among these, **vector-borne diseases** such as Dengue and Chikungunya have sparked the most concern. Indeed, the altered distribution of these diseases is likely to put island health systems under additional stress. In remote islands, health facilities are often basic and ill-equipped to deal with such cases. This could also create issues with the International Health Regulations, which impose measures of confinement that might be difficult to implement in island environments. Furthermore, climate change induced migration can also significantly reduce the confinement capacities, as evidenced in a recent article by Schwerdtle, Bowen, McMichael & Sauerborn (2019).

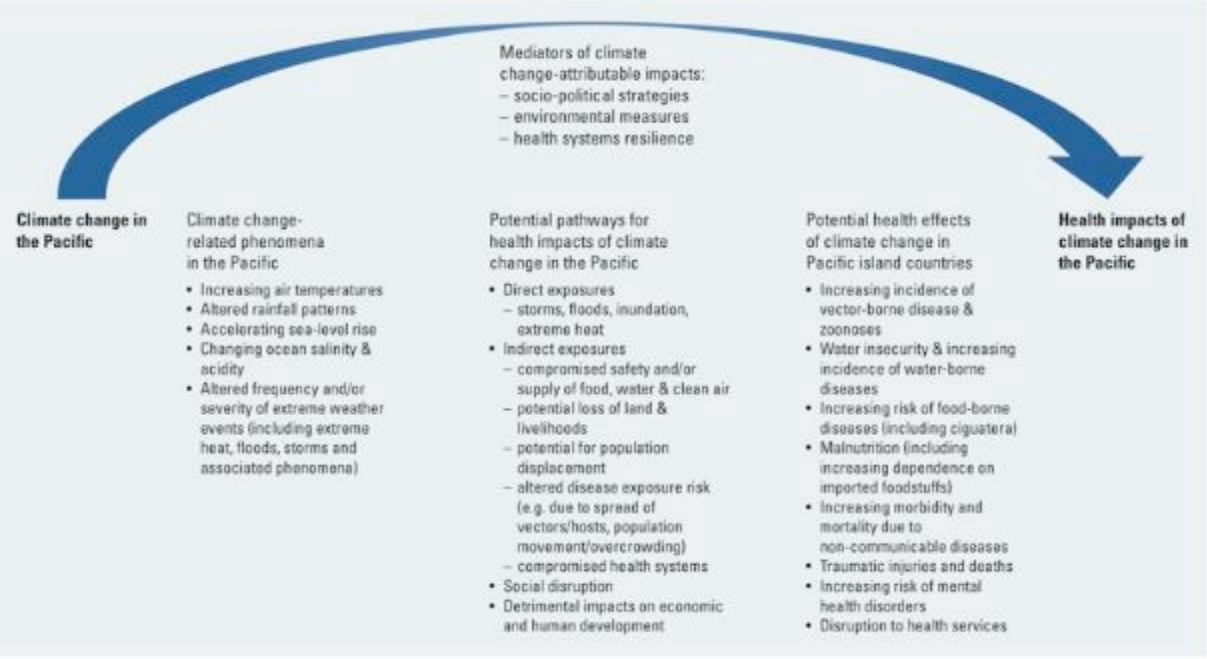

Figure 5 - Climate change and health impact pathways relevant to Pacific island countries. Source: McIver et al., 2016.

3. Competition for resources

Among the climate effects that will impact the Pacific, sea-level rise will significantly reduce the resources available to populations. Seawater will contaminate underground aquifers, while increased soil salinity will reduce agricultural yielding and fertile land availability.

Without proper management and governance, this situation might drive a competition for natural resources, within or between islands. Traditional dispute resolution schemes and practices might prove unfit, in some cases, to resolve such disputes, which might then escalate into conflicts. Such mechanisms have already been observed in other parts of the world, such as the Horn of Africa, and can be heavily compounded by poor governance systems.

4. Violence due to mismanaged adaptation or migration

In a milestone policy paper released at the end of 2018, the New Zealand Ministry of Defence (2018) notes that:

> *"climate migration has already caused some community-level conflict within the Pacific. Across the region, there have been instances of communities being split up for relocation, some being moved to areas with different cultures without prior consultation with the host communities, and others being moved into already crowded areas. In such cases, there have been reports of low-level conflict over land – sometimes deadly – and reports of increased levels of violence, including against women and children. When not well managed, climate migration has the potential to heighten security concerns, in the Pacific and extending into both maritime Southeast Asia and South Asia."*

Even though migration *per se* does not represent a security threat, its management can indeed raise security concerns. For example, the relocation of villagers from the Carteret Islands to Bougainville has split up communities and created localised conflicts about land tenure in Bougainville (Naser, 2015). Similar issues have been observed in Vanuatu after the relocation of the Ambae island population, following the eruption of volcano Manaro Voui in september 2017. Such experiences punctuate the necessity for peace-building approaches to relocation that involve both migrants and destination communities.

Similarly, adaptation measures can yield unintended effects, often gathered under the concept of **maladaptation** (Magnan et al., 2016). An adaptation strategy that can be beneficial to one community, for example, can prove detrimental to another community. Migration and relocation processes are likely to induce diverse – and possibly contrasted – effects on the communities of origin and destination. It is the case, for example, when environmental and other resource pressures are transferred (perceived or actually) from the former to the latter. This is why it is essential to consider a diverse range of viewpoints when devising an adaptation strategy, especially when it involves migration movements, which can result in a positive outcome for some communities but have detrimental impacts upon others (Gemenne & Blocher, 2017).

5. Land disputes

Finally, the potential for new or inflamed land disputes must be considered. **Land tenure in the Pacific often remains governed by traditional customs**. Localised disputes related to land tenure are already relatively common and are likely to be exacerbated by climate change. Such conflicts are particularly likely to occur where relocations occur with active consideration of land tenure issues and, where no alternatives exist, careful negotiations with traditional land-owners. Different initiatives have been taken in recent years by organisations such as the UN Food and Agriculture Organisation (FAO), and the Pacific Islands Forum (PIF), to better regulate land tenure in the region. Regardless, there will remain an issue of scarcity – land not being available for freehold purchase because it is vested in customary title.

As land is expected to become a scarcer commodity as a result of sea-level rise and other climate change impacts, it is likely that there will be an increasing **need for improved certainty of land tenure, and for land tenure dispute resolution mechanisms**. There is indeed an inherent tension in the Pacific between collective and individual land rights, which will likely be exacerbated by climate change, since the region presents a continuum of land rights arrangements that range from freehold to informal settlements.

2. Vulnerability of key infrastructure

Climate change is challenging the resilience of critical infrastructure in the South Pacific region. As the effects of climate change intensify, the risk to critical infrastructure increases over time. Resilient infrastructure is essential to supporting human security, peoples' livelihoods and their communities. Reduction in services and facilities resulting from impacts to critical infrastructure can have detrimental effects on the wellbeing and mental health of those in a community. The needs of the population and the social, cultural and economic services most relevant to individual communities should be at the centre of plans to improve the climate resiliency of critical infrastructure across the South Pacific region. Armed forces must also have resilient infrastructure as they are expected to be amongst the first to intervene in support of the population. Moreover, they must be able to respond in the case of damage to critical civilian infrastructure even in the most remote areas.

This section seeks to identify what kind of key infrastructure is affected by climate impacts in the region and to assess the risks posed by climate change to infrastructure by 2030. However, it is important to keep in mind that a longer term perspective is needed, as infrastructure will outlast the timeline of 2030 chosen for this study.

I. Identification of the key infrastructure at risk

For the purposes of this study, critical infrastructure can be broadly understood to include "systems, assets, facilities and networks that provide essential services and are necessary for the national security, economic security, prosperity, and health and safety of nations".[2]

Infrastructure in the South Pacific region is particularly vulnerable to the impacts of climate change, with accelerated rural-urban migration over the last half-century and with significant population centres now situated in low-lying and vulnerable coastal areas. SPDMM member countries also have population centres away from coastal areas, yet infrastructure in these areas remains vulnerable to the impacts of climate change through extreme weather events, increased precipitation and drought.

A report commissioned by the Australian Government in 2012 helped identify what could be labelled as key infrastructure in the Pacific (Baker and Week 2012). This report drew a typology of key infrastructure based on the key functions it fulfilled:

- **Providing the basic well-being** of the population: such infrastructure include housing, water systems, and waste / sanitation systems.
- **Delivering government services:** such infrastructure includes health centres and hospitals, schools and universities, as well as government and justice buildings.
- **Enabling economic activity**: transport infrastructure (roads, bridges, airports, ports and jetties), ICT systems, energy infrastructure, as well as economic infrastructure related to agriculture, fisheries and tourism.

[2] http://www.infrastructure.govt.nz/publications/critical5/crit5-narrative-v2.pdf

The report noted that "transport infrastructure (was) particularly critical in the Pacific, because of the highly dispersed population and the need to move goods and services across large areas" (Baker and Week 2012). This is even more evident when a disaster strikes, as transport infrastructure is essential for the provision of emergency relief.

The following table assesses the influence of major climate impacts on key infrastructure assets in the Pacific.

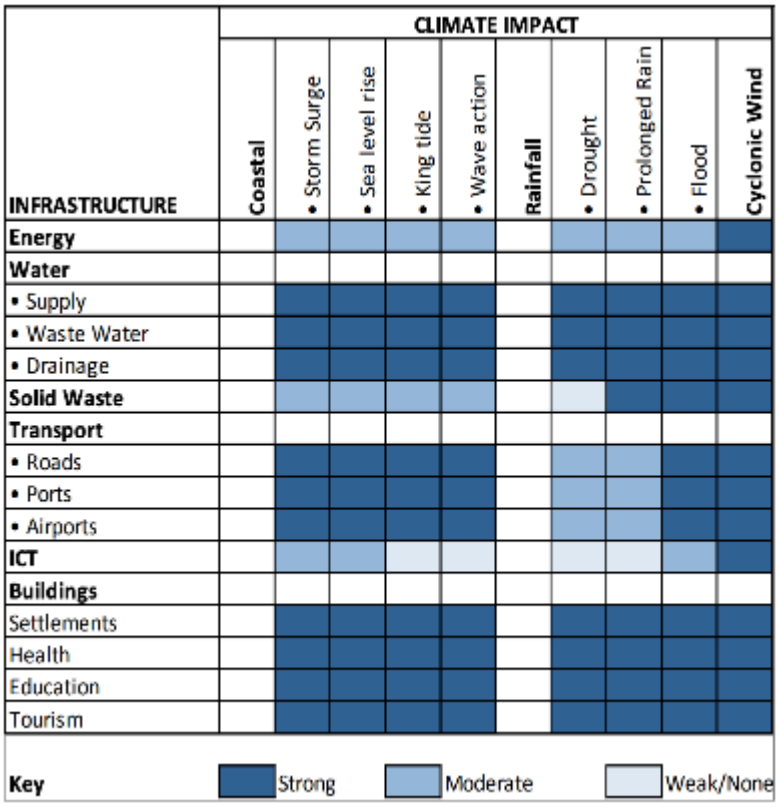

Figure 6 – Overview of major climate impacts on infrastructure assets in the Pacific. Source: Baker and Week 2012.

Infrastructure located in coastal areas is particularly vulnerable – this includes roads, airports, ports, housing and other critical infrastructure along the coast, and essential services such as power supplies, telecommunications, the provision of potable water and health care facilities.

Vulnerable infrastructure is particularly prevalent in small island countries. A recent study by Kumar and Taylor, conducted in 12 Pacific island countries (PICs)[3], shows that "57% of the assessed built infrastructure is located within 500 m of their coastlines, amounting to a total replacement value of US$21.9 billion. Eight of the 12 PICs have 50% or more of their built infrastructure located within 500 m of their coastlines" (Kumar & Taylor, 2015). The situation is even more striking in Tuvalu, Kiribati and the Marshall Islands, which all have more than 95% of their infrastructure built within 500 m of their coastlines.

[3] The Cook Islands, Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Niue, Palau, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu. Fiji was not included in the study.

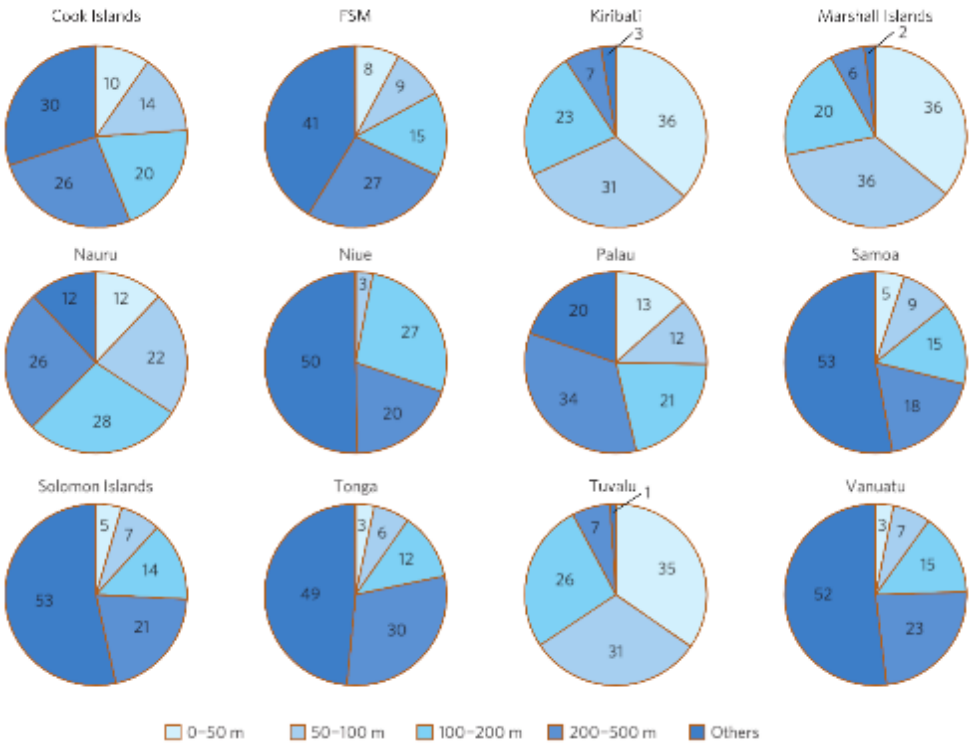

Figure 7- Counts of built infrastructure (percentage of country total) within each interval from the coastline for 12 countries of the Pacific. Source: Kumar & Taylor, 2015

It can be noted that, military infrastructure was not considered in this report (Kumar & Taylor, 2015), and is usually treated independently from civilian infrastructure. A report from the Australian Academy of Technological Sciences and Engineering (ATSE) was produced in 2008 to assess the vulnerability of Australian infrastructure but did not address specifically military infrastructure (ATSE 2008). The report however proposed a systemic methodology that considered not just climate impacts in a quantitative definition, but rather a systemic approach that sought to propose an adaptation trajectory for Australian infrastructure.

For **coastal infrastructure**, the intensifying effects of climate change will continue to accelerate coastal erosion and other costal hazards in our region. Sea level rise will continue to pose extreme challenges to the South Pacific's collective coastal infrastructure—this will be exacerbated if Antarctica continues to warm over time.

Infrastructure that will be affected by sea level rise includes **wharfs, jetties and support infrastructure of ports and harbours**. These structures will be affected in a variety of ways, including through the symptoms of simple inundation events such as alkali-silica reaction or 'concrete cancer', erosion and corrosion, and through the more immediate and catastrophic damage caused by wave action.

Figure 8 – Coastal landing strip in Samoa. Source: Baker and Week 2012.

Infrastructure close to the sea in many nations also includes **power, water and road networks**. In many circumstances, the resilience of these facilities and structures will depend on the type of foundations and the type of soil. When the foundations of infrastructure are regularly saturated, through coastal inundation or king tides, the bearing capacity will weaken over time, ultimately making the infrastructure unstable or unable to fulfil its role.

Figure 9 – Transmission poles in Timor Leste after a storm. Source: Baker and Week 2012.

Much of the infrastructure built along the coastlines of South Pacific nations has been erected to support **industries that rely upon the sea**. These industries may be dually impacted by climate change-induced changes (e.g. changes or reductions in fish stocks) along with the damage and degradation of their supporting infrastructure such as wharves and storage facilities. As the effects of climate change become more apparent, insurance premiums may

become unaffordable for these industries, or insurance companies may refuse to provide coverage at all, especially if the companies themselves experience economic hardship. Without insurance, reliance upon aid, emergency services and other government agencies will increase.

Critical infrastructure located inland will also be tested and affected by the impacts of climate change. With increasingly variable rainfall patterns across the region, flooding events and landslides will become more prevalent, challenging the pace and feasibility of adaptation. Conversely, some nations will experience drought and rainfall reductions that will impact inland infrastructure such as dams and road networks, as the soil and foundations may dry, shrink and crack.

Further, **climate change will render damaging fire events more common in some countries,** such as Australia. Variable rainfall patterns mean that shrubbery and undergrowth may flourish in the rainy season, then dry out dramatically and become fuel for wildfires in the dry season. Wildfires may threaten homes and critical infrastructure and put increased pressure on government services and other remaining infrastructure.

Building infrastructure resilient to extreme natural disasters is essential to protect populations, reduce damages and costs and ensure continuous provision of services. But it is also important **to be able to restore quickly destroyed infrastructure when a disaster strikes**, in order to mitigate the damages, facilitate humanitarian access and prevent the post-disaster situation from worsening.

More importantly, **due to the strong interdependence and interconnectivity of the Pacific countries, vulnerability of infrastructure should be considered at the regional scale and not only within the territory where it is located**. It is particularly true for airports, many Pacific island countries being heavily dependent on imports of fossil fuels, foods, etc. For some small island countries, the risk of being completely cut off from the rest of the world because of disruption of regional air traffic, should not be underestimated. For instance, Tuvalu deeply relies on imported food products transiting through Fiji's airport so any damage or problem disrupting the functioning of this airport will inevitably impact Tuvalu's capacity to import food. Vulnerabilities are thus interconnected in the region as a damaged infrastructure somewhere can have consequences in other parts of the Pacific region. Specific attention should be given to infrastructure in remote islands, where provision of vital and basic services might be compromised in case of disruption of infrastructure such as airports.

II. Risk assessment by 2030

The effects of climate change that are affecting infrastructure in the South Pacific region include:

- A mix of slow-onset events such as rising temperatures and sea level rise—the Western Pacific Ocean is rising at about three times the global rate of around three millimetres annually;
- More variable rainfall patterns and prolonged droughts;

- More rapid onset events, notably the increasing frequency and intensity of extreme weather events such as storm surges and tropical cyclones.

This section delineates how these different risks are likely to affect infrastructure in different parts of the South Pacific region by 2030. It highlights in particular the risks posed to the infrastructure of French island territories in the region, as these can serve as examples of the risks posed to other island territories in the region.

1. France

Though France has not yet undertaken a systemic review of its critical infrastructure in the Pacific[4], some elements of infrastructure are likely to be particularly vulnerable.

a) Transport infrastructure

Transport infrastructure relies mostly on road transport, with a circular road in most islands. Apart from a few bus lines, there is not real public transportation network in French Polynesia, and the circular road has been repeatedly flooded over the last few years.

Figure 10 – Inundation of the circular coastal road in Papeete during cyclone Oli (2010).

There are currently 54 airports active in French Polynesia. Most of these consist of a mere landing strip: in 2016, only four airports welcomed more than 100,000 passengers: Tahiti Faa'a, Bora-Bora, Raiatea and Huahine.

These airports have been flooded on a series of occasions during storms and represent a key factor of vulnerability to climate impacts: **most of the liaisons between the different islands rely on air transport**. Most of these airports and landing strips are located on the coastline and

[4] http://www.nouvelle-caledonie.ademe.fr/domaines-dintervention/changement-climatique/contexte-territorial

are thus particularly vulnerable to flood risks. Floods can also be induced by extreme rainfall events, which are likely to become more frequent by 2030. In January 2018, the airport of Tahiti-Faaa got flooded as a result of extreme rainfall.

Figure 11 – Inundation at Tahiti-Faaa airport, January 2018. Source: La Dépêche de Tahiti.

New Caledonia counts some major airports: Nouméa Magenta, La Tontouta, two others on the main island and four on each of the main outer islands. Its geographical configuration, however, is fundamentally different from French Polynesia: New Caledonia is a continental island group, while French Polynesia is made up of coral atolls. Therefore, **New Caledonia presents a mountainous environment, less vulnerable to sea-level rise and floods**. The public transportation network is also more developed.

b) Energy infrastructure

Electricity production continues to rely heavily on fossil fuels, and this is the case in both French Polynesia and New Caledonia, but also in Wallis & Futuna. Though renewable energies have enjoyed a steady growth over the past few years, French territories in the South Pacific remain dependent on fossil fuels, with many coal and fuel oil plants, particularly in New Caledonia. Energy infrastructure is still advanceing and there are plans to have more wind farms and solar panels by 2030 in New Caledonia. Currently, energy infrastructure is rather vulnerable – not just from an environmental perspective, but also from an economic perspective.

In Australia, increasingly intense and frequent heatwaves over the past decade have affected electricity networks. The high temperatures both had physical impacts on infrastructure, while also triggering a higher demand for electricity for air conditioning, leading to the need to conduct 'load shedding', where certain electricity supplies were closed or reduced in order to provide electricity to essential sectors.

c) Health infrastructure

There are seven hospitals in New Caledonia – four are public, three are private. In Polynesia, a network of dispensaries is well maintained and evacuation procedures to Tahiti are well established. Basic health facilities are usually available on the main islands and in Tahiti, the

Centre Hospitalier de la Polynésie française (CHPF) gathers all of health services, in Pirae. It is located a mere 200 m away from the coast.

d) Military infrastructure

France has a significant military presence in the Pacific, as shown on the map below.

Figure 12 - France and Security in the Indo-Pacific. Source: Ministry of Armed Forces 2018, p.7

Military bases typically suffer from the same vulnerabilities as civilian infrastructure. There is however a specific sensitivity for military infrastructure that has to be noted, as climate impacts might prevent from fulfilling certain essential missions, especially if climate impacts combine with each other.

Typically, vulnerability assessments of military infrastructure remain overly deterministic, and do not envision adaptation trajectories, nor the importance of local context.

Though the risk of submersion is the key concern for French infrastructure in the Pacific, the combination of this risk with other climate risks cannot be underestimated. Current zoning relies on the identification of an impact zone for sea-level rise, combined with topographic information, as shown in the diagram below. Other climate impacts should however be incorporated in such assessments.

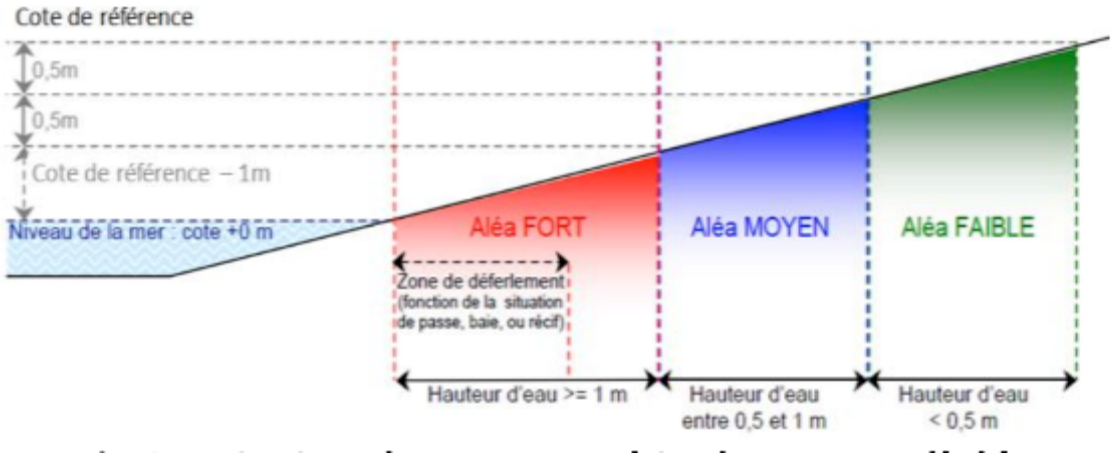

Figure 13 – Cartography of zones at risk of submersion. Source: Kit pédagogique sur les risques naturels en Polynésie Française, Gouvernement de Polynésie française, 2013.

In New Caledonia, significant coastline retreat has been observed since the mid-2000s. This retreat is often of about 2-3 meters but can reach up to ten meters in some places. Such coastal retreat is particularly striking in the north of New Caledonia, in the Loyalty Islands (Wallis et al. 2014). On Ouvéa in the Loyalty Islands, which is particularly affected, authorities are currently considering the possible relocation of the Saint-Joseph tribe, affected by regular floods. In French Polynesia, the Tuamotu archipelago is also particularly under threat. Provision of basic services to populations living on remote islands is already compromised as a result of climate change, and this situation should considerably worsen by 2030. In general, the legislative framework of climate policies in French overseas territories will need to account for the fact that outer, more remote islands are likely to be much more vulnerable to climate impacts. The provision of basic services and the resilience of key infrastructure will be crucial in adaptation policies for these territories.

2. Australia and New Zealand

New Zealand has an extensive coastline, with most of its major cities located on the coast. A 2018 estimate from New Zealand's Ministry for the Environment suggests that $19 billion of assets in New Zealand are at risk from sea level rise and flooding events—including five airports, 50 kilometres of rail, 2,000 kilometres of road and 40,000 homes. New Zealand's main naval base, Devonport, located along Auckland's coastline is particularly vulnerable to slow-onset effects from sea-level rise.

Similar to New Zealand, forecast impacts of climate change may directly affect Australian Defence's infrastructure and bases. This includes the possible impact of sea level rise, flooding, storm surges and coastal erosion at bases and training areas. A large number of key Defence installations are at or just above sea level. As Australia's infrastructure ages, there is an increased likelihood of climate change impacting Defence base operations in the short to medium term.

In order to assist Pacific partner nations to increase their resilience, Australia has recently announced the creation of the Australian Infrastructure Financing Facility for the Pacific, a $2 billion initiative designed to support important infrastructure projects across the Pacific Islands

and Timor Leste, with grants and loans delivered in lock step with partner countries, international organisations and the private sector.

3. Other SPDMM countries

More work is needed to assess the impacts of climate change on the military infrastructure of SPDMM countries. However, it is clear that the impacts of climate change will continue to present a challenge to critical infrastructure, including defence infrastructure across the region.

In most SPDMM countries, the economic value of coastal infrastructure is usually very high (see figure below). Typically, the value of such infrastructure amounts to more than 75% of the total value of the infrastructure of the country.

Many SPDMM countries have already experienced the risks that climate change poses to critical infrastructure. **Papua New Guinea**'s Department of Defence notes that roads, ports and wharfs, hydroelectric dams, power distribution lines and telecommunications towers are at risk from the impacts of climate change across the country.

Sudden-onset effects across the region are prevalent. When category 4 Cyclone Gita struck the South Pacific in February 2018, particularly **Tonga** and **Fiji**, it demonstrated the vulnerabilities of essential infrastructure in both countries. Many of the "landmark" buildings in Tonga's capital Nuku'alofa were badly damaged or destroyed. The meteorological office and national radio station were both taken offline. Cyclone Gita was upgraded to a category five tropical cyclone after battering parts of southern Fiji. The storm hit the southern Lau island group, where homes, food and plantations were destroyed, and communications cut off.

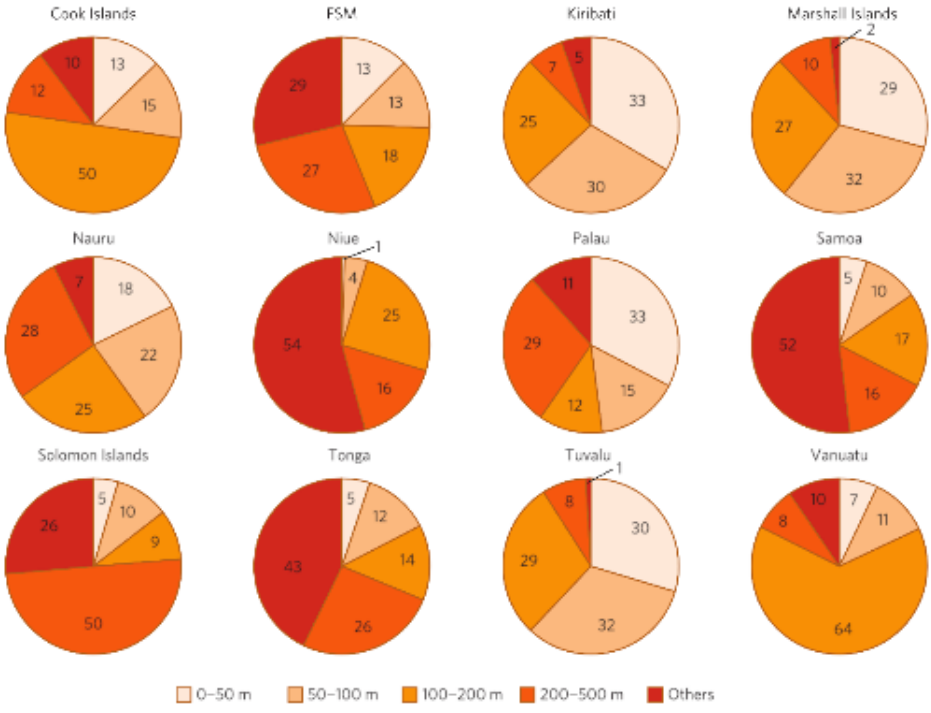

Figure 14 – Replacement value of built infrastructure in 12 Pacific Island Countries with each interval of the coastline. Source: Kumar and Taylor 2015.

In its 2017 **Climate Vulnerability Assessment**, government of Fiji identifies climate vulnerability as a serious obstacle to its development objectives, especially due to large impacts of natural hazards on transport infrastructure, housing and public services (Government of Fiji et al. 2017). Important efforts have been made, with support from development partners, to reduce country's vulnerability through an improvement in infrastructure management. While cyclone Winston in 2016 provoked massive damages in Fiji, authorities have been able to rapidly restore infrastructures services such as electricity or airport services. Since cyclone Winston, the government has also started various projects to further increase Fiji's resilience towards natural disasters. For instance, it established the Construction Implementation Unit to ensure reconstruction in the education and health sector is done with higher resilience standards. It also commissioned a countrywide bridge vulnerability assessment that prioritizes maintenance and reinforcement investiments in the road sector. Improving infrastructure services in various key sectors (transport, water, power, flood and coastal protection, health, school) has been identified as priority areas of intervention to make Fiji more resilient to climate change (Government of Fiji et al. 2017).

Although not linked to climate change, the 2010 **Chile** earthquake and tsunami damaged transport and communication networks in the country, severely impacting the capability of authorities to bring support to affected populations. Because of climate change, the increase of extreme events, resulting in river overflows and floods is also posing challenges to the resilience of the Chilean public infrastructure, affecting road works, bridges, ports, and water infrastructure. In its "Proposal for a Portfolio of Measures to Prepare the climate change Adaptation plan for Infrastructure", Chile analyzes the different climate models and their potential impacts on its infrastructure. A number of threats putting their functioning at risk are thus identified. Among these, the coastal impacts of climate change (sea-level rise, storm surges, erosion, swell, etc.) particularly threaten coastal infrastructure and hinder littoral infrastructure project developments. Chile's Ministry of Public Works is also currently elaborating on an action plan to address infrastructure affected by climate change.

3. Humanitarian challenges

The effects of **climate change** in the Pacific region are **exacerbating a range of humanitarian challenges.** On a regional level indeed, several stressors will lead to increased demand upon regional militaries and other security-focused institutions to conduct Humanitarian Assistance and Disaster Relief (HADR) operations or provide other types of assistance. Regional cooperation on HADR has already grown substantially since the 2000 years in response to the many natural disasters that regularly struck the Pacific region.

I. Regional concerns

1. Climate change impacts and related general challenges

The effects of climate change tend to compound problems related to low economic development, population density, poor governance, weak government institutions, poverty and food insecurity, which can lead to inter-group rivalries, water, food and resource shortages and irregular migration.

Climate change is predicted to have **significant impacts on crops** with likely short-term crop failures and long-term decline in production leading to higher prices. Declining traditional food sources and available fresh water combined **will adversely impact the health of Pacific communities** (MRAG Asia Pacific, 2010).

Climate change also has the potential to **affect cultural practices and traditional livelihoods**. Those who rely on growing traditional crops will face increased levels of soil salinization due to sea level rise, and the possibility of coastal inundation from king tides, which may detrimentally affect the viability of these food sources. Communities which rely on fishing and the ocean will notice declining or relocated fish stocks over time with increased warming and ocean acidification in the rise[5], meaning that they may have to rely upon alternative food sources or aid to support their communities (Bell et al., 2012). Further, traditional housing and infrastructure may not be resilient to the effects of climate change such as storm surges, extreme weather events, rising sea levels and increased drought. Without attention and protection, nations in the South Pacific may lose the capacity to practice their cultural traditions, along with it their sense of community and identity.

With dramatic changes to the natural environment – from sea-level rise to increased levels of unproductive land – alongside damage to infrastructure and the livelihoods of coastal communities in the South Pacific region, **climate-induced migration will become a reality for more communities over time**. It has already occurred within countries in the Pacific in recent years, and in some cases the displacement or relocation of communities has agitated tribal conflicts, placed strain upon resources and ultimately led to a reduction of community resilience and cases of increased violence.

[5] This is expanded further in the section on maritime zones.

All these stressors will lead to increased demand upon regional militaries and other security-focused institutions to conduct stability operations or provide other types of assistance.

In addition, **it is also important to consider the cumulative effects of natural disasters**. If a cyclone of category 1 hits soon after a cyclone of category 5, it will be much more damaging than in a normal situation.

2. HADR regional system: international military implication frames

In the South Pacific region, where only Fiji, Tonga and Papua New Guinea, alongside New Zealand, France and Australia, possess a standing defence force, **international operational forces constitute a key disaster response stakeholder.** The cooperation of armed forces at a regional level, both with local, international governmental and civil instances, is of critical importance in HADR. The presence of international operational forces depends on several norms, agreements and conventions binding military stakeholders, civil society and states (UNOCHA, 2018).

Delivery of **humanitarian aid is often quite dependent on military forces, as military personnel are trained to** provide logistics, assist in the transportation of humanitarian food, material and staff, and build or rebuild infrastructure as required. Military personnel are also capable of conducting these activities in difficult contexts such as in devastated and hard-to-reach areas, and under resource stresses. International forces may thus be mobilised on demand of states or non-governmental organizations (NGOs) within the frame of civil-military cooperation agreements such as the UN resolution 46/182[6], the "IDRL Guidelines"[7] of the Red Cross and Red Crescent, etc. Mobilization requests can be official (request forms) as well as informal (direct contact between disaster response stakeholders).

A range of multilateral agreements allow for regional operational cooperation within the frame of HADR: for example the FRANZ agreement (concluded in 1992 between France, New Zealand & Australia), allows the signatory states to coordinate the civil and military means engaged in disaster response. Operational cooperation is also led by multilateral military simulations and exercises (such as *Southern Katipo*, *Croix du Sud*, *Tropic Twilight*, etc.) that provide training to forces which could be mobilized in HADR actions. Those exercises contribute to enhance interoperability between regional armed forces.

Bilateral cooperation around HADR is already quite developed between regional and external states. For example :

- The **USA** assistance materializes as military training and expertise offer and funds (via the *Foreign Military Financing*) for local troops. Support troops are sent quite seldom (US Department of State, 2018).
- **China** owns a military hospital-ship that occasionally tours the Pacific region to provide medical support to disaster exposed islands. China also aids local troops by providing

[6] The United Nations General Assembly resolution 46/182 defines the role of the UN in coordinating international humanitarian assistance when a government requests external support. The resolution establishes a number of UN mechanisms to strengthen effectiveness of international humanitarian action, namely the Central Emergency Response Fund (CERF), the Consolidated Appeal Process (CAP), the Emergency Relief Coordinator (ERC) and the Inter-Agency Standing Committee (IASC). Resolution 46/182 was unanimously adopted by UN Member States in 1991.
[7] Guidelines for the domestic facilitation and regulation of international disaster relief and initial recovery assistance.

equipment and uniforms but tends to mainly focus its action in the Pacific region on substantial economic investments.

- **France, Australia and New Zealand** have all concluded agreements with regional Small Island Developing States (SIDS), regulating their contribution and military mobilization in the case of natural disasters.

3. Current and future military challenges

With the increasing intensity and severity of many diverse weather events (tropical cyclones, extreme rain, storm surges, etc.), combined with predicted wider cyclone paths, **HADR will become more complex in two notable ways**. The first is responding in areas where extreme weather events occur more regularly. With **shorter recovery periods between disasters**, affected populations and key infrastructure assets are likely to come under unprecedented stress. The second is that with the widened tracks of cyclones, **some places in the Pacific will experience tropical cyclones for the first time**, or areas where cyclones were rare may experience these events more frequently. Communities, security forces and response agencies will need to be prepared for the aftermath of more frequent and severe extreme weather events.

The increased frequency and intensity of extreme weather events in the region is likely to see a more urgent and frequent need for HADR and other operations. These trends alongside business-as-usual activities (such as other deployments and exercises) will likely **stretch regional resources,** leading to **more concurrent operational requirements**, with potential for multiple events occurring in the region within the same timeframe. The South Pacific region also faces a range of other natural disasters not related to climate change but that also require HADR, notably earthquakes and volcanic eruptions. Such events may strain or complicate resource requirements and increase pressure on response capacities, if they occur at the same time as climate-related disasters.

With the intensifying impacts of climate change, **defense forces and other security or response entities will be required to act in more challenging circumstances**. For example, regional forces will be required to operate in environments that are exposed to higher heat stress, with heatwaves becoming more common, resulting in greater health threats to personnel. This will have both short term and long-term **effects on the mental and physical health of personnel, and this reality will require active preparation, monitoring and potential follow-up assistance or treatment**.

In this context, increased climate-related migration over time will also give rise to a number of related security problems: for instances, challenges to territorial sovereignty, illegal entries or insecurity of spontaneous migrants. Accordingly, it is extremely important that **climate migration or relocation of affected communities is thoroughly planned in order to mitigate potential security challenges** resulting from land disputes, inter-community misunderstandings, and resource scarcity. Ongoing community education or socialisation of these challenges may ameliorate some of these issues in the future. Cultural identities and traditions need to be protected as much as possible to support continued community resilience in already difficult times. Given the increased likelihood that militaries across the region will be sent to provide assistance in relocating people – even after a natural disaster – it is important that the military personnel comprise cultural advisors (similar to those employed in major operations theatres).

However, some have cautioned that **frequent military and humanitarian operations alike in the South Pacific region may threaten traditional resilience mechanisms** and to bring about a growing dependency of the local populations to external aid (Hollis, 2015). SPDMM countries can work together to mitigate this risk, by improving cross-cultural understanding , especially as the need for humanitarian assistance and disaster relief missions will likely increase in future as a result of climate change impacts. At the same time, civil-military security mechanisms should be further enhanced or in some cases developed.

II. Local issues

Because of its Pacific overseas territories[8], France owns the second biggest Exclusive Economic Zone (EEZ) in the world. Thus, the region constitutes a major economic, territorial and strategic area for the country, which consequently developed a solid security and defense strategy allowing for efficient operational coordination with local and international HADR civil and military players.

1. France

a) Examples of climate change impacts on France's Pacific territories

French Pacific islands and other regional territories display common vulnerabilities that tend to increase the impact of natural disasters when they occur: small territories, distance from national logistics centers, isolation and archipelagic dispersal, concentration of populations on shorelines, steep slopes and watercourses (Arnell, 2018). These territories suffer from a delay of equipment and development, and a lack of infrastructure (particularly in communication and networks), nevertheless decisive for alert and crisis management.

A recent example: Cyclone Oli. In January 2010, French Polynesia was hit by one of the five most powerful tropical cyclones that ever happened in Polynesia since the 1970s, cyclone Oli (level 4 on the Saffir-Simpson scale). Even though Oli did not lead to any deaths, it caused economic losses estimated at 68 million euros (Canavesio et al., 2014). Cyclone Oli caused a important crisis and mobilized all the forces of the country for several weeks: an airlift led by the High Commission, a sea bridge by the local government and land reinforcements to restore the lines of communication and power networks. The relocation of some individuals has encountered land issues (the question of indivision of land property) and individual reluctance (refusal to resettle far from the coast).

Climate change will impact the spontaneous migration patterns and affect the shape of regional displacement plans and policies. In the case of French territories, French Polynesia and Wallis and Futuna are already experiencing a net migration deficit due to employment patterns, with young people leaving more and more island territories to join New Caledonia and the metropolis. It is very likely that these territories will continue, in the future, to gradually lose their population under the pressure of climate change. This migration will threaten the conservation of local cultures and traditions still very important in the Pacific island territories.

[8] New Caledonia, French Polynesia, Clipperton Islands and Wallis-and-Futuna.

Moreover, it is very likely that climate change will require increased relocation of populations living in the most dangerous areas, which could lead to tensions between these communities, unwilling to leave, and the authorities.

b) Disaster preparedness and response in the French Pacific territories

In order to support crisis management stakeholders, **several research organizations are charged with climate risks monitoring & forecast in the Pacific and for the French territories**. They play a significant role in the development of public policies on natural disaster prevention & management.

- **Météo-France** ensures the national public service of meteorology, the monitoring of the climatic risks and the long-term forecast in order to better foresee climatic changes. It has an inter-regional management in New Caledonia (also in charge of Wallis-and-Futuna) and another in French Polynesia. However, the insufficiency of the technical resources of Météo-France to ensure its monitoring and forecasting missions was pointed out. Therefore, it is essential to invest in tools dedicated to climate risk prediction, in order to better support crisis management stakeholders (e.g: project SPICy in La Réunion, aimed at developing an experimental forecast system for cyclone related floods).
- **The Bureau of Geological and Mining Research (BRGM)** (offices in New Caledonia and in French Polynesia) assesses the coastal risks in a context of climate change to understand cyclonic phenomena, swells or erosion.
- There is also a **Regional Specialized Meteorological Center (RSMC)** in cyclone monitoring for the territories of the South-East Pacific (including New Caledonia and French Polynesia) based in Suva, Fiji and designated by the World Meteorological Organization[9]. The South Pacific is also monitored by national meteorological services.

Relief efforts in French territories are provided for in the French *ORSEC* plans which come under the jurisdiction of the French State, except in New Caledonia. In French Polynesia and Wallis and Futuna, the prefect or high commissioner is in charge of the overall governmental response, in partnership with the local authorities. They are assisted by the *Interministerial Defense and Civil Protection Service* (SIDPC), a *Defense & Security Area Officer*, and the *Interministerial Zone Staff* (EMIZ). In French Polynesia, maritime and air rescue coordination services are pooled (Arnell, 2018).

The *Directorate General for Civil Protection and Crisis Management* (DGSCGC), which reports to the *Ministry of the Interior*, is the key contact supporting overseas territories in the event of crises. It has a fleet of 26 aircraft (mainly water bombers and MFPs) and 35 multi-mission helicopters (EC145), but none are permanently deployed in the Pacific territories. It also has three army engineering regiments that intervene in civil security and are composed of military salvors.

***The Interdepartmental Operations Center for Crisis Management* (COGIC) is the body in charge of operational crisis management**, capable of quickly transforming itself into a command staff. The means of the DGSCGC can be deployed in reinforcement of the local means, as it was the case in the Antilles during the passage of cyclone Irma in 2017.

[9] Official website of the CMRS based in Suva: http://www.met.gov.fj/about_us.php

Civil security is based on firefighters and on civilians and soldiers attached to the civil security services of the State. **The human and material resources of civil security are globally modest in the ultramarine territories**. The ratio of firefighters per 1000 inhabitants is between 2 and 3 for the three French territories of the South Pacific, compared to 3.7 for the whole of France (Arnell, 2018).

c) French armed forces' role in HADR in the Pacific region

The French armed forces play an important in the Pacific region, both in the French overseas territories and the neighboring small island states: as one of the major military players of the region, France is frequently asked to provide HADR assistance to states in the region, along with Australia and New Zealand. **Between 2007 and 2018, the French armed forces** – be it the gendarmerie, land or air armed forces, or national navy – **deployed 18 times in the Pacific** for humanitarian operations, on the French territories or in support to affected regional countries: 14 times due to cyclonic episodes and 4 times during floods (DGRIS, 2018).

French military mobilization in HADR relies on two complementary armed bodies, constantly present in the Pacific theater:

- The **French Armed forces in New Caledonia (FANC)**, have a prevalence in Air Land operations, and their responsibility zone extends on the whole Melanesia. The FANC consist of 1,680 personnel and can notably be mobilized on HADR operations within the frame of the FRANZ Agreements or of bilateral cooperation such as the CASTOR missions. They can also mobilize four surveillance and/or patrol ships, one helicopter, two *Guardian Falcon* surveillance planes and two *Casa* transport planes.
- The **French Armed forces in French Polynesia (FAPF)**, cover the East part of the Pacific Region. However, their navy expertise may bring them to intervene in the West, additionally to FANC action. The FAPF manpower amount to 1180 soldiers, with one surveillance frigate, one patroller, three *Guardian* surveillance planes, two *Dauphin* helicopters and two *Casa* transport planes.

However, the intervention capacities of the French armed forces in these areas are just sufficient to meet current needs for intervention on national territories (see figure below). New Caledonia is equipped with two patrol boats which are over 30 years old, about to be decommissioned. French Polynesia only has one patrol boat, which, for the time being, meets the needs of the navy but will not be enough in the near future if the missions assigned to the French forces become more frequent or onerous under the pressure of climate change. Renewal of overseas patrol boats is provided for in the 2019-2024 Military Programming Act (Arnell, 2018).

As far as the French national territory is concerned, **coordination between civilian and military forces is provided locally by the zone prefect**, and between the ministries of Interior and Defense at the national level. (Arnell, 2018).

Allowing military cooperation and coordination between France, Australia and New Zealand over emergency HADR in the Pacific region, **the FRANZ agreement (cf. II.a.) has emerged as an effective tool** and is often presented as a case of exemplary civil-military regional cooperation. Its adaptability was underscored as a vector of particular efficiency (Gero et al., 2013). On the French side, the response missions planned under the FRANZ agreement are

financed in part by the Ministry of Europe and Foreign Affairs (MEAE), via its humanitarian emergency fund.

Cyclone Pam, which devastated the Vanuatu archipelago on March 2015, makes an example of French military action within the frame of the FRANZ agreement: one of the most intense cyclones ever recorded in the South Pacific, Pam destroyed 90% of Port Vila's infrastructures and caused economic damages estimated at two-thirds of the country's GDP (Rey et al., 2017). Seventy percent of the population was affected, but the human toll remains low (eleven deaths) thanks to an effective preparation for cyclonic risk. Faced with the scale of the disaster, the Vanuatu government sought international assistance. France responded quickly, mobilizing the FANC (with a support of the FAPF), the unit of intervention of the civil security of New Caledonia and the French Red Cross, within the framework of the FRANZ agreements.

France is also engaged in pilot research programs that could benefit the whole Pacific region. Launched in 2017, the ***Bar-tailed godwit Programme*** is a France-led long-term commitment in the Asia-Pacific focusing on the study of transpacific migratory birds' in-flight behavior. This scientific program, initiated by the French ministry of Armies, contributes to early warning alert systems for cyclones[10].

d) Current and future military challenges

The current and future military challenges underscored in the regional overview also apply in the French Pacific territories. They will necessarily impact French military interventions both on foreign and national territories of the Pacific region. With stronger and more frequent weather events on extended areas, shorter recovery periods, the HADR military and humanitarian resources will be put under unprecedented stress.

Increasingly solicited for HADR operations, French armed forces will have to prepare for more frequent interventions in more challenging circumstances: more devastated theaters, destroyed or damaged crucial infrastructure such as airports, seaports and roads, etc. As a matter of fact, the French troops deployed in the Pacific have already been experiencing the limits of their capacities in regard to the requirements of their missions: CASA planes and PUMA helicopters, for instance, are not fitted for massive population evacuations. Thus, the French capacities (navy, aircraft, soldier's training, etc.) will necessarily have to meet the evolutions of the field circumstances (see recommendations).

New strategies will have to be thought and designed concerning the distribution of French military interventions on national or foreign territories. Indeed, while France engaged in regional HADR support alongside Australia and New Zealand (e.g. FRANZ agreement), it will also have to deal with increasing disasters on its own Pacific territories, which would come first on the priority list if a disaster occurred both on national and external territories, and for which reserve contingents would need to be available anytime.

As climate change impacts will increase over time, **it is likely that, in absence of sufficient displacement planning, spontaneous migration will increase, causing legality and security**

[10] https://www.defense.gouv.fr/dgris/presentation/evenements/barge-rousse-un-projet-scientifique-inedit-7-avril-2017

issues both in the region and on the French territories. While France will increasingly need to manage illegal entries on its territories, its troops may be more and more mobilized on population relocating and settling operations, but also rebuilding missions on damaged areas and transportation of humanitarian food, material and/or staff in hard-to-reach areas.

2. Australia, New Zealand and Fiji

Due to strong historical and cultural links, Australia and New Zealand are key and primary partners of the South Pacific island states in the fields of defense, development assistance, post-disaster situations, and transboundary security challenges. Both countries also host important diasporas from neighboring small island nations.

a) Disaster preparedness and response in Australia

Australia's approach to HADR reflects its strategic outlook of the Pacific region, with the rendering of assistance to and by partner nations seen as essential to the stability of the region and a valuable means of building cooperation and providing assurances to neighbours and likemindeds.

From an Australian perspective, a more prosperous and secure Pacific increases mutual opportunities for trade and investment. It deters potential risks from challenges such as transnational crime; biosecurity problems; illegal, unregulated and unreported fishing; and threats to borders and maritime exclusive zones. If a natural disaster threatens one country's stability or prosperity, it will almost inevitably reverberate to others. The scale of many natural disasters also means that they are often transnational in scope and are usually beyond the capacity of any one country to respond to its own, thus requiring regional cooperation. In that sense, **natural disasters are framed by Australia as a security challenge that requires a collective regional response**, **as well as collaborative efforts to build resilience and facilitate adaptation.**

The Department of Foreign Affairs and Trade (DFAT) is the lead agency for managing and delivering Australian HADR deployments in the region. It is responsible for coordinating participation in relief efforts by various Australian government agencies, including the Australian Defence Force (ADF).

Australia's **2017 *Foreign Policy White Paper*** that recognizes the different challenges that climate change will pose to the country and the Pacific region in the coming years, as well as the opportunities of energy transition (Government of Australia, 2017). This document highlights current Australian efforts to boost its capacity to respond to natural disasters, stating that "when disasters strike, within 48 hours Australia can deploy relief supplies, humanitarian specialists and health and urban search and rescue teams" (ibid. p.87).

In order to bolster Australian capability to support regional disaster preparedness and response, **the country has also set up a new integrated deployable civilian capacity, named Australia Assists**[11]. This is the result of a collaboration between DFAT and RedR (an international humanitarian agency) and is based on the strengths of the Australian Civil Corps

[11] https://www.redr.org.au/australia-assists/

(ACC)[12] and the humanitarian response roster of RedR Australia. Australia Assists has created a roster of over 750 highly skilled humanitarian experts able to work with overseas partners to build resilience and provide emergency relief – before, during and after the crisis – especially in the Pacific region (cf. annexes).

Australia is also contributing to strengthening the Pacific low-lying island states' capacity to respond to climate change, by providing **$300 million over four years (2016-2017 to 2019-2020)** to help governments and people in the Pacific build climate change and disaster resilience and pursue cleaner developments pathways[13].

Further, the **Indo-Pacific Endeavour** is a major maritime activity and one of the Australian Defence Force's most important annual activities. It is a key contributor to regional security and stability and deepens Australia's engagement and partnerships with regional security forces. Indo-Pacific Endeavour visits the South-West Pacific every second year, the last iteration in 2018 saw the Joint Task Group conduct military-to-military engagements and joint training activities designed to develop shared understanding, trust and the capacity to jointly respond to events in our region. The activities reinforce Australia's regional relationships and security and humanitarian and disaster relief response capabilities.

In 2018, the Indo-Pacific Endeavour Joint Task Group's first port of call was Fiji followed by Vanuatu, and Tonga – where five Unimog trucks were gifted to His Majesty's Armed Forces of Tonga. The Joint Task Group also visited Samoa, the Solomon Islands and Papua New Guinea to conduct training and community engagement activities, including women in leadership and medical workshops, and maintenance work to local schools, community facilities, and historic sites. Planning for Indo-Pacific Endeavour 2020 has commenced with an ambitious program of activities in the South-West Pacific under consideration.

In this regard, Australia's priorities also include :

- Supporting the participation of regional security forces in Australian Defence Force (ADF) joint training courses;
- Working with other regional partners, the US, New Zealand and France, to maximise the effectiveness of regional capacity building activities;
- Providing funding for Pacific island countries seeking to assist other countries in humanitarian response and surveillance efforts, predominantly through fuel and victual support to deploying Pacific Patrol Boats.
- Increasing use of private sector/commercial capabilities for restoration of key infrastructure or disaster relief (e.g. the use of Australian linesman to restore power infrastructure in Tonga post Cyclone Gita in 2018);
- Conducting bilateral and multilateral whole-of-government planning exercises.

The Australian Defence Force (ADF) is proactive in providing humanitarian support throughout the region, and also contributes to building capacity and resilience in regional partners. When the Australian Government accepts a request for assistance from a regional partner, the Department of Foreign Affairs and Trade will lead the Australian Govrnent response which will be contributed to by a number of other government agencies and

[12] The Australian Civil Corps is an Australian government sub-agency created in 2011 that recruits and deploys civilian specialists to provide aid to developing countries in cases of conflicts or natural disasters. It is a component of the Australian Agency for International Development, AusAID.
[13] https://dfat.gov.au/geo/pacific/development-assistance/Pages/resilience-pacific-regional.aspx

departments. Within this broader context, the ADF ADF will contribute logistical support andspecialized military capabilities that are not available from other Australian agencies, or not readily available through commercial contracts The Australian Government provides assistance both within Australia and in neighboring countries in the South Pacific and South East Asia.

Within Australia the ADF provides support to the State and Territory jurisdictions by providing aid through emergency Defence Assistance to the Civil Community (DACC). When conducting DACC tasking the ADF acts in a supporting role to State, Territory and Commonwealth agencies providing logistical support and specilised military capabilities.

Some examples of support provided by the ADF include:

- The **Royal Australian Navy** can mobilize its amphibious vessels (HMA Ships Adelaide, Canberra and Choules), helicopters and additional equipment, as it was the case during the typhoon Haiyan that hit the Philippines in 2013[14].
- The **Australian Regular Army** can provide specialized command and control functions as well as engineering and logistical effects including medical and transportation.
- The **Royal Australian Air Force** can assist by transporting humanitarian aid, personnel and equipment – including the Australian Medical Assistance Team (AUSMAT) and Urban Search and Rescue (URSA) teams. They can also provide logistics and medical support when requested such as Aero-Medical Evacuation[15].

During tropical cyclone Winston in 2016, up to 1 000 Australian Defence Force personnel provided humanitarian support, delivering critical aid supplies to local communities in Fiji, repairing critical public infrastructures, and conducting hundreds of assessments of infrastructure. In total, the ADF's operation during the cyclone Winston was the following[16]:

- Air Force, in tandem with Navy's HMAS Canberra and Army's 16th Aviation Brigade, conducted more than 40 C-17A Globemaster and C-130J Hercules dispatches between Australia and Fiji;
- Over 114 tons of humanitarian assistance and disaster relief and 140 tons of aid including food, shelter kits, tents, construction materials and humanitarian supplies, were delivered by Australia to Fiji;
- Power to four villages and water facilities to 700 people was provided;
- A large number of temporary shelters were constructed;
- Nine schools, three medical centers, five community centers and four churches were repaired quickly;
- Approximately 340 assessments of infrastructure by Australian Army Engineers with Fijian civilian and military experts were conducted.

[14] http://news.ntu.edu.sg/SAFNTU/Documents/Panel%205%20-%20Brigadier%20Peter%20Gates.pdf
[15] For a more detailed presentation of the role of the Royal Australian Air Force in international humanitarian interventions, see: https://www.airforce.gov.au/operations/humanitarian-support
[16] https://www.airforce.gov.au/operations/humanitarian-support/recent-history-air-force-humanitarian-assistance

b) Disaster preparedness and response in New Zealand

New Zealand experiences a range of natural disasters, from earthquakes to extreme weather events exacerbated by the impacts of climate change. For events in New Zealand, the Ministry of Civil Defence and Emergency management takes the lead in preparation and response coordination. This Ministry has a National Crisis Management Centre (NCMC) which 'facilitates the Central Government crisis management arrangements and offers inter-agency and scalable operability to deal with any type of emergency'[17].

As outlined in the New Zealand Government's Strategic Defence Policy Statement 2018, the highest priority for the New Zealand Defence Force (NZDF) is "its ability to operate and undertake tasks in New Zealand's territory (including its EEZ) and its neighbourhood, from the South pole to the Equator" (New Zealand Government, 2018, p.29). This encompasses a range of activities including humanitarian assistance and disaster relief operations in the face of increasingly severe and disruptive weather events.

The NZDF is a supporting agency in the event of a large-scale natural disaster. The force plays a crucial role in supporting communities and other government agencies following natural disasters. A recent example of support is NZDF assistance in helping rebuild South Westland's Waiho River Bailey Bridge, which was washed away by torrential rain and rock-filled flood waters in late March 2019. The NZDF contributed 18 Army engineers from the Army's 2nd Engineer Regiment, experienced in Bailey bridge construction to support the numerous sub-contractors in rebuilding this crucial piece of infrastructure[18]. The bridge connects Fox Glacier with Franz Josef in the South Island.

[17] https://www.civildefence.govt.nz/about/national-crisis-management-centre/

[18] New Zealand Transport Agency. "NZ Defence Force, Downer help Transport Agency rebuild Waiho River Bailey bridge", url: https://www.nzta.govt.nz/media-releases/nz-defence-force-downer-help-transport-agency-rebuild-waiho-river-bailey-bridge/

Figure 16. Damaged Waiho River Bailey Bridge after torrential rain in March 2019. Source: RNZ, 2019.

New Zealand stands by its Pacific neighbours in times of need following disasters requiring humanitarian assistance and disaster relief. As outlined by New Zealand's Ministry of Foreign Affairs and Trade, "New Zealand's response to a disaster offshore depends on the indented needs and requests from the affected country government. New Zealand adopts a partnership approach to managing natural disasters. This includes a 'whole of Government' commitment and working closely with the private sector, non-government organisations, the United Nations and other donors"[19].

A recent example of this kind of response can be seen through New Zealand's response to Tropical Cyclone Gita, which left a trail of damage in the Pacific in February 2018. New Zealand swiftly swung into action to support Pacific partners including by promptly setting aside $NZ 2.33 million to help emergency response efforts and by sending a 10-person interagency team to Tonga on 13 February to scope support. The NZDF provided a P3-K Orion aircraft to conduct aerial surveillance of the damage and sent six C130 flights to Tonga to deliver relief supplies[20].

The 2018 Defence Assessment on Climate Change highlighted that: "The impacts of climate change will require more humanitarian assistance and disaster relief, stability operations and search and rescue missions." It further notes that the Defence Force may be faced with more

[19] New Zealand Ministry of Foreign Affairs and Trade. "How we respond to disasters". url: https://www.mfat.govt.nz/en/aid-and-development/disaster-and-humaniterian-aid/

[20] New Zealand Ministry of Foreign Affairs and Trade. "Cyclone Gita- New Zealand Response". Url: https://www.mfat.govt.nz/en/aid-and-development/disaster-and-humaiterian-aid/cyclone-gita-new-zealand-response/

frequent and concurrent operational commitments. The findings of this assessment are being used to inform the review of New Zealand's Defence capability[21].

c) *Disaster preparedness and response in Fiji*

Fiji's disaster management arrangements are clearly articulated in its National Disaster Management Plan (NDMP) of 1995 and its subsidiary legislation the National Disaster Management Act (NDMA) of 1998.

Fiji's disaster management arrangements was put to the ultimate test during Tropical Cyclone Winston in 2016 in term of having adequacy in capacity and mechanisms to enable Fiji to cope and manage an event of such magnitude.

While some aspects worked well there is a need to modernise these existing arrangement to be on par with the modern day requirements of any disaster or emergency operations.

One of the key things that worked well as per the findings of the review of the whole TC Winston operation was that the RFMF coordinated key elements of the overall response well, including the deployment and use of foreign military assets. Military resources, particularly personnel and equipment, enabled a rapid scaling-up of the disaster response operations, far in advance of what would have been possible with a civilian capabilities alone.

Given the significant value of Fiji's military support provided during the TC Winston response there is a need clearly articulate the military's role in existing disaster legislation and policies to ensure that it is better understood by all.

The Asia-Pacific guidelines on Military Assistance to Disaster Relief Operations could be a useful reference to draw on in identifying the ideal arrangements for Fiji.

To further enhance our civil military coordination efforts there is a genuine need for further training for Fiji's military personnel in humanitarian assistance and protection principles to better inform their work in this important space.

In terms regional humanitarian response, Fiji deployed its first ever regional assistance to Vanuatu in the aftermath of TC PAM, deploying a self - sustained composite team of NDMO officials, medical and health personnel(fully equipped) and a unit of military structural engineers (fully equipped).

Other Military Forces present in the Vanuatu Response operations included the Australian Defence Forces, the NZ Defence Forces, the French Military deployed out of New Caledonia, the Tongan Defence Forces and Solomon Paramilitary.

In light of recent events like TC PAM (Vanuatu), TC Winston (Fiji) and TC Gita (Tonga), regional assistance has become eminent as never before and now requires urgent reviews of regional co-operations mechanisms and regulations. There is a need to have discussion on how to

[21] Beehive New Zealand Government. "Defence Assessment on Climate Change and Security Released". Press release, 6 December 2018 by Hon Ron mark and Hon James Shaw. Url: https://www.beehive.govt.nz/release/defence-assessment-climate-chnage-and-secuirty-released

establish such regional response mechanisms and regulations under a proposed regional body to support intra-regional humanitarian response for both disaster and climate change events.

One such concept worthy of consideration is on a Triangular Taskforce Concept under the FRANZ umbrella where France, Australia and New Zealand provided the strategic lift and assets and Fiji contributes personnel (NDMO/Health/RFMF Engineers) to support any disaster or climate change emergency or relief deployment across magnitude or scale of event.

Fiji currently reviewing its NDMP and NDMA to take into consideration the new modalities to support strengthening Fiji's disaster management arrangement and better its response to any disaster event of TC Winston magnitude and devastation or for an emergency operation in Fiji.

This includes building up our capabilities and accreditation across key areas of Fiji's comparative advantage like disaster management, public and preventative health care and engineering to support any regional humanitarian response in the near future.