Conference Papers

Special Edition

CLIMATE CHANGE, A CHALLENGE FOR DEFENCE: A view from the South Pacific Region

Delivered by the "Academic Cooperation Network"
of the South Pacific Defence Ministers' Meeting

SPDMM

SOUTH PACIFIC
DEFENCE MINISTERS' MEETING

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The content of each article is the sole responsibility of the authors, who comply with the technical standards required for their preparation. They were also peer-reviewed by experts from other countries participating in the conference as a way to verify their content, quality, validity, and relevance to the proposed topic. Some of these articles, were previously published in other scientific or defence journals.

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Prologue

The publication "Climate Change, a Challenge for Defence. A Perspective from the South Pacific" is the first publication of the Academic Cooperation Network, within the framework of the South Pacific Defence Ministers' Meeting (SPDMM). It is a pioneering initiative of its kind, whose purpose is to promote analysis and reflection focused on the reality, problems, and challenges of the South Pacific countries.

The aim is to contribute to a debate that began in this part of the world and seeks to transcend its geographical area, incorporating other actors who, through their specialised knowledge, can support this effort at dialogue and collaboration between countries, contributing their experience and vision of the issues addressed.

The meeting between authorities and the privileged conversation that takes place in these instances can be enhanced by the thematic contribution of their academic institutions. This Academic Cooperation Network between Study Centres and Higher Education Institutions belonging to the Ministries of Defence and the Armed Forces of the SPDMM member countries, created 2 years ago, has spent the last 12 months developing a joint publication, which has now been made available to the defence community.

I am convinced that this first publication, of many more to be produced from this initiative, will be a mandatory reference when seeking to understand the specific perspectives of the countries that are part of the South Pacific.

I invite you to read carefully what each country and its representatives are proposing, as I am sure it will deepen your understanding of the issues addressed.

Sincerely,

VA (R) Ronald McIntyre
Director of the National Academy on Political & Strategical Studies (ANEPE)
Chilean Ministry of Defence

Introduction

During the South Pacific Defence Ministers Meeting in 2023, a proposal was made to create an "Academic Cooperation Network" between study centres and institutes belonging to or linked to the Ministries of Defence and Armed Forces of member countries, with the aim of promoting joint analysis, academic discussion, and the exchange of studies and publications that are useful to SPDMM member countries, particularly studies and research related to security challenges in the region.

This publication is the first concrete contribution to the academic cooperation network, containing various articles proposed by some of the member countries on the topic of "climate change and security in the South Pacific countries." These papers contain the authors' views or perspectives on the aforementioned topic, raising the challenges they pose for defence, with a particular view of the country, but always with a perspective within the South Pacific.

The content of each article is the sole responsibility of the authors, who comply with the technical standards required for their preparation. They were also peer-reviewed by experts from other countries participating in the conference as a way to verify their content, quality, validity, and relevance to the proposed topic.

Some of these articles, were previously published in other scientific or defence journals.

Finally, we would like to thank all member countries for enabling the implementation of this project, which promotes the exchange of academic information on the main security challenges in the South Pacific region. This allows the organization to have products that provide a comprehensive vision, from which new alternatives for cooperation can be identified.

Climate Change and Army Personnel – a South Pacific perspective*

Colonel Philip Hoglin, Australia.

*This article does not necessarily reflect the views of the Australian Government. An earlier version of this article was previously published as Australian Army Research Centre. (2024). *Climate change and Army personnel*. Australian Army Journal, 21(1). https://researchcentre.army.gov.au/library/australian-army-journal-aaj/volume-21-number-1/climate-change-and-army-personnel.

Introduction

In a 2024 article in the *Australian Army Journal*, Dr Albert Palazzo was necessarily blunt in his assessment of the impact of climate change on the future characteristics of war, stating that 'Australia and the ADF will have to adapt if the nation is to meet the demands of operating in a more violent and decisive climate change era' (Palazzo, 2024). Unfortunately, Palazzo stands with just a handful of others in articulating the extent to which climate change will affect the Australian Defence Force (ADF). As has been the case for much of the last century, the understandable default of military academics and strategists seems to be authorship on topics perceived to have a greater appeal to the usual military audience, such as those focusing on military operations, acquisitions, technology, and national security.

In this article, defence policy and the discussions of several security analysts will be extended to consider the practical impacts of climate change on the members of the Australian Army. In particular, the article will focus on the effects of climate change on individual soldiers, their families, and the training and career systems. Importantly, in line with advice from the Department of Climate Change, Energy, the Environment and Water, this article considers climate change to be inevitable (Department of Climate Change, Energy, the Environment and Water, 2024). Therefore, the discussion does not speculate about whether there *may* be impacts on Army, but takes the perspective that there *will* be impacts—with the only variable being *when* those impacts will occur.

Summary of the Strategic Literature

The 2024 National Defence Strategy (NDS) included seven brief references to climate. It recognised:

'The effects of climate change are amplifying existing stressors across the region, such as poverty, food security and cross-border migration and displacement. These effects may also intensify transboundary tensions and have impacts on Australia's national security. The increasing frequency of climate events will place higher demands on the ADF for humanitarian assistance and disaster relief operations regionally and domestically, placing greater stress on ADF capability, capacity and infrastructure. There remains potential for state volatility which could require support from Australia or the broader Pacific family'.

In response to these identified impacts, the NDS states that '[t]he Government will continue to invest in security relationships within the Pacific family, working together to achieve shared

security objectives, build partner capacity, enhance interoperability and address common challenges, including […] mitigating the effects of climate change.'

Similarly, the Defence Strategic Review (DSR) dedicated just five brief paragraphs (about half a page) to the topic of climate change; three of them lamented the concurrency of the ADF's contribution to disaster relief against the provision of military capability. In this context, the issue of climate change itself was not directly addressed. Further, while the DSR stated that '[c]limate change is now a national security issue', (Department of Defence, 2023, p. 41) it was noncommittal as to the degree to which this is the case. Using speculative language, it stated: 'If climate change accelerates over the coming decades it has the potential to significantly increase risk in our region'. At least one commentator noted that the language of the DSR was not useful given that it is a broadly accepted fact that climate change will accelerate and it will increase risk; speculative language serves to diminish the immediacy of the threat (Glasser, 2023) and its moral implications (Storey, 2024).

Among security commentators, there is broad consensus that climate change poses 'a national security threat to Australia through the stability of the region and national capacity to respond' (Parker, 2022). There is a consistent theme recognising the climate/security nexus: 'climate change effects lead to environmental impacts, and environmental impacts create social impacts, which lead to security implications'. Influential authors (including those affiliated with the Australian Strategic Policy Institute (Copage, 2024) and the Australian Security Leaders Climate Group (ASLCG) (Australian Security Leaders Climate Group, 2022, p. 4), the United Nations Framework Convention on Climate Change (United Nations Climate Change, 2022), the United Nations Security Council (United Nations, 2023) and a Senate standing committee (Senate Standing Committee on Foreign Affairs, Defence and Trade, 2018) take this view. Indeed, the Senate Standing Committee on Foreign Affairs, Defence and Trade concluded that there is 'consensus from the evidence that climate change is exacerbating threats and risks to Australia's national security' (Senate Standing Committee on Foreign Affairs, Defence and Trade, 2018, p.91).

In developing a pathway toward lower greenhouse emissions, Defence's recent Net Zero Strategy (Department of Defence 2024a) and Future Energy Strategy (Department of Defence, 2024b) acknowledge the national security threat of climate change. Frustratingly, the strategies are also not-committal in the realities of the threat, positing '*if* climate change accelerates' rather than unambiguously accepting the realities of an accelerating change (emphasis added). The strategies are developed in response to the Climate Change Act 2022 (Australian Government, 2022) and are necessary of themselves, but don't address the impact of climate on Defence capability, Defence members and their families, or the personnel management system.

While the national security threat posed by climate change is broadly acknowledged, and the 2024 strategies go some way to describing a way forward with respect to emissions, earlier criticism that 'the ADF has only limited awareness of the extent of the disruption and military challenges that climate change may create' (Gosling Clark, 2023) remain valid. Indeed, there remains 'a refusal to accept the size and immediacy of climate risk in 2024' (Australian Security Leaders Climate Group, 2024, p. 1), an observation that extends to the impact of climate change on ADF members themselves. In an effort to redress this situation, Palazzo explains the implications of climate change in practical terms for warfighting strategy. This includes the need for a larger ADF, emphasis on self-reliance, participation of the entire Australian citizenry, and consumption of national wealth. Palazzo has ominously surmised that 'war will resume its place as one of the great forces for human decision-making' (Palazzo, 2024).

Overall, despite the recent release of Defences' strategies, security and climate change are rarely written about by Australian security specialists. It is significant that Palazzo's contribution on climate is unique among the numerous articles in the *Australian Army Journal*. Notable too is Michael Evans's nuanced opposing view in the *Australian Journal of Defence and Strategic Studies*; he argues that there is no direct causal link between climate change and conflict (Evans, 2021). Among the dozens of other defence and security advocacy groups and think tanks, only one is focused specifically on climate change and national security in the Australian context—the ASLCG, whose members include a former Chief of the Defence Force and a former Vice Chief of the Air Force (Australian Security Leaders Climate Group, 2024). Others provide a regional focus, as the Australian Strategic Policy Institute does through its Climate and Security Policy Centre (Australian Strategic Policy Institute, 2024). Overall, despite the dozens (or hundreds) of articles written every year by Australia's military strategists, the paucity of discussion on a change that is inevitable, in favour of speculation on hypothetical strategic scenarios that may never occur, is both disappointing and alarming.

Significantly, to the degree that Australian-focused articles and reports exist, they are written without the benefit of the classified 2022 Office of National Intelligence climate and security risk assessment, which would greatly add to national debate and understanding (and of which the ASLCG has called for the release of an unclassified version) (Australian Security Leaders Climate Group, 2024, p. 4; Evans, 2024).

Australia's Changing Climate

It is inevitable that there will be more extreme weather events in Australia. However, Army has not yet considered how the regions affected by these events will overlap areas of large Army populations. For example, modelling shows that in military locations in the north of Australia there will be a significant increase in the number of days when the wet bulb temperature exceeds 30°C (Figure 1) (Aldhous, 2024) . At this temperature the work-to-rest ratio often becomes less than 50/50 (in scenarios involving heavy work), which is a ratio that may be untenable for both effective outdoor training and the conduct of operations by regional force surveillance units. The ASLCG points to the resulting extreme living difficulties that will confront members and their families posted to these locations in their efforts to conduct normal, everyday activities (Australian Security Leaders Climate Group, 2024). It is predicted that by 2050 some urban locations such as Darwin will experience between 66 and 129 more days over 35°C each year, as global average warming reaches between 2°C and 4°C (113 to 176 days per year in total) (Climate Council, n.d.).

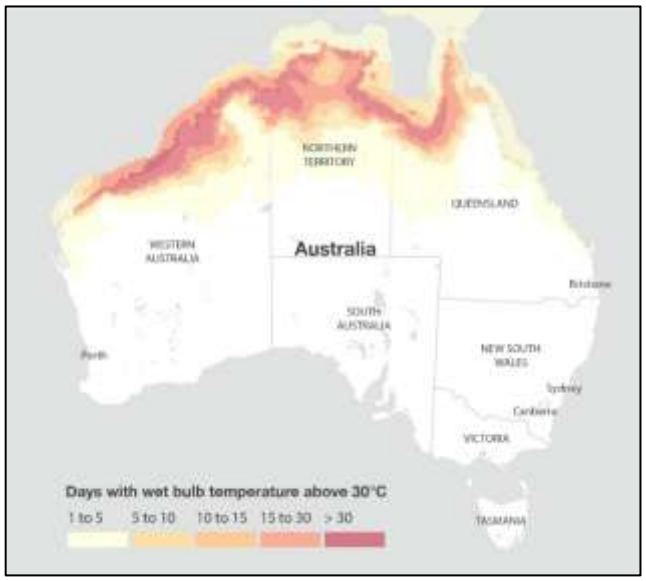

Figure 1. Days with wet bulb temperature above 30°C
Image credit: Peter Aldhous, based on data from Probable Futures (Probable Futures, n.d.)

Extreme heat events are not the only problematic consequence of climate change. Modelling also predicts an increase in the annual likelihood of drought, exceeding 50 per cent in many geographic areas of Australia (Figure 2) (Aldhous, 2024). This situation will increase the impact of dust and exposure on equipment, decrease foliage and its stability, increase the likelihood of irreparable environmental damage to training areas, and threaten the viability of some training areas for continued heavy vehicle use, including manoeuvre-based activities. As identified by Palazzo, 'platforms optimised for environmental conditions that no longer exist may have to be modified or scrapped' (Palazzo, 2024). Finally, the same modelling indicates that almost all of Australia can expect increased rainfall should there be the one in 100 years storm in a world warmed by 3°C. Such an outcome would disrupt all ADF training activities in proximity.

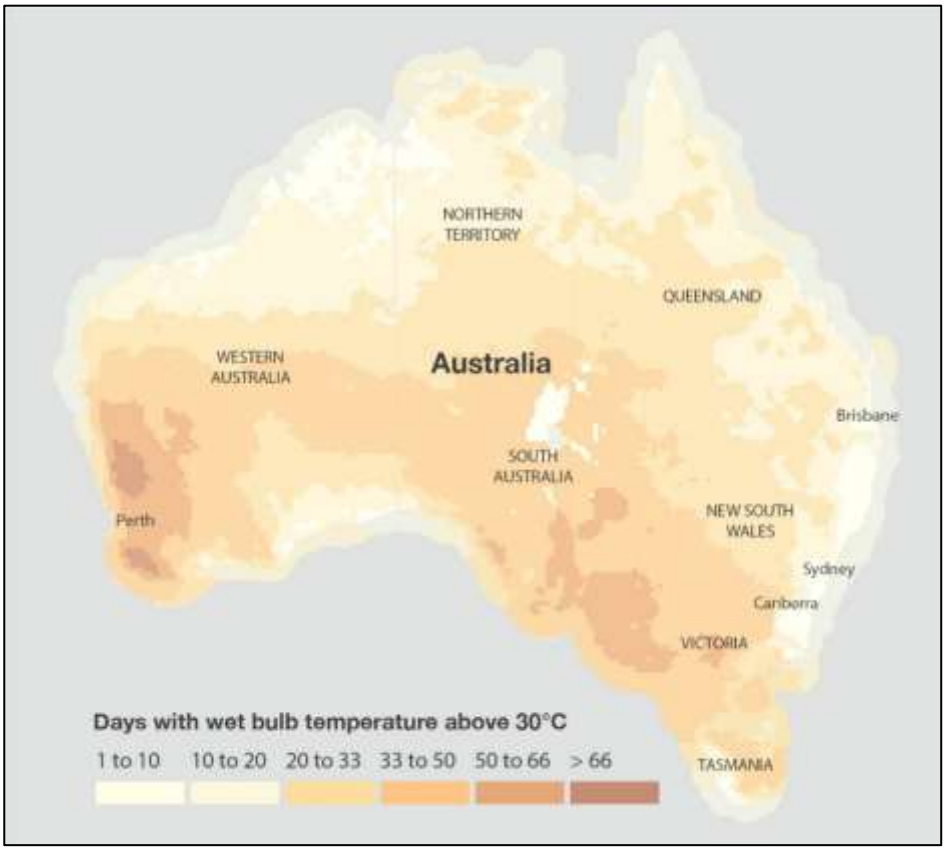

Figure 2. Annual likelihood of extreme drought (Aldhous, 2024)
Image credit: Peter Aldhous, based on data from Probable Futures

Climate Change and Army

So far, aside from a few localised extreme weather events, Army has been lucky to avoid much of the worst of climate change; most has occurred away from Army's major bases. However, already this century there have been two major floods affecting members posted to RAAF Base Amberley (and nine floods in the greater Ipswich area) (Ipswich City Council, 2022); Townsville was flooded in 2019; (National Emergency Management Agency, 2019)https://researchcentre.army.gov.au/library/australian-army-journal-aaj/volume-21-number-1/climate-change-and-army-personnel and road access between the Northern Territory and South Australian elements of 1 Brigade were cut during flooding in January 2022 (National Emergency

Management Agency, 2022). Between February and April 2022, Defence Housing Australia reported 565 flood-damaged properties in south-east Queensland and parts of coastal New South Wales, and in April 2024 Holsworthy experienced extreme rainfall that closed training areas (Defence Housing Australia, 2022). Luck will soon run out. In the next decade (and beyond) Army can expect an increased frequency and severity of extreme weather events in major unit locations and training areas. Drought, floods fires and prologued heatwaves will have a direct impact on training, training outcomes, families and ultimately capability.

Training Area Availability

One of the more obvious consequences of climate change will be its effect on Army's training areas and facilities. Major training areas including Mount Bundy, Bradshaw and High Range will be unavailable for longer periods due to inaccessibility, infrastructure damage, terrain alteration, or more frequent occasions where the temperature exceeds wet bulb globe restrictions (Australian Army, 2022). Remediation of damaged infrastructure and terrain will close specific areas for lengthy periods. Live-fire ranges will face more frequent heat-related closure due to fire risk, resulting in increasing demand for the limited days available and prioritisation of use. Not only will there be constraints on a unit's ability to train; an unstable planning and training environment will also emerge—one that that will be at the mercy of weather that is extreme, unpredictable and dangerous.

Adverse environmental effects will not be limited to the ADF's better-known training areas. Bare bases, including Curtin and Scherger, and training areas near Katherine, will also be unusable for substantial periods. Joint and combined exercises conducted from these locations will face the prospect of cancellation or rescheduling, while exercises using the Shoalwater Bay Training Area will experience the immediate devastation of adverse weather and may also suffer disruption through coastal erosion, with obvious effects on capability and mobilisation readiness. The resultant diminution in individual and collective skills and proficiency will compromise Army's capability until the deficiency can be remediated under more favourable weather conditions. These effects will be felt across almost all capabilities—for example, infantry minor tactics will be constrained to benign and controlled barracks environments, and drivers will be unable to exercise on varying and complex terrain. In addition, flying opportunities for drone operators will be impaired and limited; the range of locations and opportunities for amphibious landing will narrow; Army will experience dust exposure during equipment maintenance and repair, including technical equipment; there will be adverse flying conditions for rotary-wing medical evacuation; and there will be increased risk to field supplies, including fuel. The list goes on.

Training System Disruption

With training areas less available, there will be inevitable consequences for the individual training system and the training continuum itself. Progressive training with substantial outdoor-based training objectives (such as officer training at the Royal Military College, Duntroon; and combat corps initial employment training) will require suspension and rescheduling. If this cannot be achieved before the notional graduation/march-out date, then Army will face the prospect of graduating officers and soldiers who have not completed the full suite of training outcomes. This will raise the spectre of Army having to deal with increased training deficiencies and backlogs. Shorter courses, such as some skills and promotion courses, will not be immune from the disruption and may face cancellation and rescheduling.

In the local unit environment, basic fitness assessments, combat fitness assessments, physical employment specification assessments and other readiness requirements will all face scheduling disruption. While these events require less planning and are simpler to reschedule than career and promotion courses, the condensed nature of many unit training programs will limit alternative opportunities for their conduct. The effects will be felt acutely in units with large proportions of service category 5 members, who have limited parading opportunities (Department of Defence, n.d.). Additionally, members requiring reassessment, those returning from injury, or those who are unavailable on a scheduled event due to any of the myriad of life events, may not be able to achieve specific mandatory training outcomes in the timeframes normally specified. This situation may put at risk individual preparedness and eligibility for courses or promotion, and again, may compromise capability.

Career System Disruption

While climate-induced disruption to the conduct of courses and training will be problematic in itself, career managers will be confronted with the likely prospect of individuals not being fully qualified for posting or promotion when Army plans to post or promote them. While this issue is not foreign to career managers (who regularly face training deficiencies in their portfolios at an individual level), climate change disruption will result in entire cohorts who have not achieved the required criteria for posting or promotion.

Posting activities themselves will be disrupted by extreme weather events. Floods and extreme heat during the usual posting period of December/January, especially in locations such as Townsville, Ipswich or Darwin, are probable. This will have an obvious effect on those posting into and out of these locations, with a domino effect through the entire posting plot across the nation. Assuming that housing is not heavily affected by an extreme weather event (a large assumption), it could nevertheless take months for the posting plot and removals planning to recover, negatively influencing family schooling and spousal employment. If housing *is* affected, then the impact on individuals and their families, belongings and possessions will be substantial and may endure for lengthy periods. In these circumstances, the potential exists for negative mental health and wellbeing consequences to emerge for members and families. This topic is discussed further below.

With large portions of Army facing posting and promotion disruption, there will be a delay in the commencement of unit training programs, which will have an immediate effect on unit capability. This will include disruption to mission rehearsal exercises and certification. Further, where there is an ongoing overseas operation, disruption to force preparation, force generation, and rotation and redeployment cycles will occur. In some instances, unpopular short-notice extensions to deployments may be imposed, with the possibility that members will return to unit locations and to families dealing with the aftermath of a natural disaster in their absence.

Finally, not completing training, or not being promoted within an expected timeframe, will affect the placement of members on their respective trade pay scales. If courses are not conducted, or if specific training objectives cannot be met, individuals will not achieve the career progression milestones specified in the Manual of Army Employments for tier and grade advancement (Australian Army, n.d.). The consequences of being held back in training, promotion and salary are self-evident: not only would a member receive less salary, but also the impact on families, morale, and motivation may be irreconcilable for individuals who seek stability and career progression. Unless Army is able to develop some creative contingencies for climate change

disruption, it will face pressure to reach a compromise on rigid longstanding progression policies. Measures in response may need to include climate-based retention contingencies.

Disruption to Families

It is not difficult to envisage the devastation that an extreme weather event will cause for families of military members, such as damage to homes and belongings. What are less obvious are the second-order effects. Suspension of schooling, damage to education facilities, or delays in arriving at a new schooling location will have an inevitable detrimental impact on children. Partners may experience greater difficulties in finding employment in an area affected by a weather event, or when they seek to transfer employment to a new location that has been affected. Housing availability will be reduced, which will result in limited options, increases in rental prices and/or dissatisfaction with defence housing. The Defence Member and Family Support agency and the Department of Veterans' Affairs will need to provide more counselling and support services. Meanwhile, Defence will face increasing demand for services including access to emergency relief. While Defence has already demonstrated that it is able to respond and provide support in a limited capacity following isolated weather events, these services will need to be provided regularly, and at times concurrently, in different locations across Australia.

Retention Issues

So far this article has presented a bleak picture of the influence of climate change on training, career and family. For Army, perhaps the worst outcome is the potential repercussion regarding retention. Delayed or cancelled training opportunities, disrupted promotion and posting, and impacts on family may all culminate in negative sentiments towards Army, and members may respond by voluntarily separating from the military. Underlining all of these issues is the ongoing likelihood that Army will still be called on to support national disaster recovery efforts, despite recommendations in the DSR that this requirement is reduced or removed (Department of Defence, 2024). Individuals may find themselves serving in an Army that is struggling to adapt to climate change, and consumed by its consequences, rather than achieving the professional and personal outcomes they envisaged when they first joined.

Regional response mechanisms

Recognising these challenges, the Department of Defence must consider novel and innovative strategies to implement the National Defence Strategy's intent to simultaneously continue to invest in security relationships within the Pacific family (including mitigating the effects of climate change), and to do so with a minimum viable capability approach.

One such mechanism is the Pacific Response Group (PRG), an initiative that was established by the militaries of the South Pacific (Australia, Chile, Fiji, France, Papua New Guinea, New Zealand and Tonga) through the South Pacific Defence Ministers' Meeting (SPDMM). The PRG enables Army, and the ADF more broadly, to deploy together with other Pacific militaries – strengthening our collective resilience and pooling our resources to burden-share.

The PRG is a regional initiative that contributes to effective Pacific-led responses in an increasingly disaster-prone region. It refines the way Pacific militaries come together to provide rapid humanitarian assistance and disaster relief. It gives effect to the call in the Pacific Island Forum's 2050 Strategy for the Blue Pacific Continent to strengthen Pacific-coordinated response mechanisms. The PRG also responds to the call from Pacific leaders in the 2018 Boe Declaration on Regional Security to strengthen regional security cooperation and collective action. PRG

planning teams can deploy upon request from an affected Pacific Islands Forum member to provide military advice to civilian authorities and scope tasks for follow-on military assets. The planning teams can be scaled to the needs of the operation.

The PRG was first proposed at the 2023 SPDMM in New Caledonia. On 3 October 2024, a detailed concept for the PRG was endorsed by SPDMM. The PRG deployed for the first time on 21 December 2024 at the request of the Government of Vanuatu following an earthquake in Port Vila on 17 December. This inaugural deployment successfully tested the PRG's ability to mobilise quickly. The Pacific Police Support Group also deployed for a brief period to support the Vanuatu Police Force.

Recommendations

In the face of inevitable climate change, Army must retain its ability to properly train its people in order to provide capability in support of national security objectives. To deal with the repercussions of climate change, Army will need to make its training, career and promotion systems more responsive and agile by developing contingency plans across a spectrum of climate risk. There may be little notice to activate contingency plans, so they must be resourced and current so that they can be implemented at a moment's notice. At present, these plans do not exist and there is limited appreciation within Army of the complexities entailed in developing them.

There are some conceptually simple approaches Army could apply to mitigate the threat of climate change disruption. While some of the suggestions below are more difficult to operationalise than others, it is worth returning to the fact that climate change is not speculation, and its impact on Army is inevitable. In this regard, developing contingency plans is not an option for Army. It is a mandatory obligation for the preservation of capability and to assure the wellbeing of Army's members and families. Extreme weather events will have a direct and immediate consequence for capability, but failure to plan for them will prolong recovery and delay the restoration of capability.

Based on the considerations raised in this article, the following recommendations are made for consideration by Army decision-makers and associated agencies responsible for personnel and capability management:

- Recognising that, as the NDS states, the increasing frequency of climate events will place higher demands on the ADF for humanitarian assistance and disaster relief operations regionally and domestically, Army should commit to a minimum viable approach, as much as is practicable, to its engagement in domestic national disaster recovery efforts. Army locations will be affected by extreme weather events and therefore Army members and their families will have their own problems to deal with in their efforts to recover and re-establish critical capabilities.
- Regional response mechanisms, such as the PRG, will play an increasingly important role in enabling the ADF to continue to contribute to Pacific-led responses to Pacific security challenges, while recognising that it will be concurrently facing compounding security risks. One of the guiding principles of the PRG – that its deployments will always nest within and support an existing civilian-led response – should similarly guide the ADF's engagement in domestic national disaster recovery efforts.
- Army should consider innovative climate-resilient approaches to the delivery of training, emphasising flexibility around timing and location of courses, in order to maintain the training continuum and capacity throughout a range of weather events.

- Training establishments should prioritise training objectives when weather events result in disruption to courses and access to training areas. Outdoor objectives and assessments should be flexible and responsive. Alternative plans and methods should be available to assess completion and competency.
- Career management agencies and supporting contractors involved in the posting and relocations process should develop systems that support inherent flexibility and responsiveness in the posting cycle to cater for mass disruption and/or short-notice delay in posting processes and relocations.
- Career management agencies should develop intrinsic flexibility in the application of promotion criteria to ensure individuals are not unnecessarily disadvantaged in career progression as a result of a weather event.
- The Manual of Army Employment should be amended to include mechanisms that allow career progression in instances where the attainment of individual proficiencies has been prevented due to climate change impacts on training, course conduct or achievement of any other mandatory requirement for progression.
- Support organisations such as Defence Member and Family Support should generate well-developed and well-resourced mechanisms to provide emergency family relief and support.
- Defence People Group, through Chief of Personnel, should develop well-considered retention plans to address the risk of climate-induced separation.

Conclusion

The Australian Army often prides itself on its agility and responsiveness. While this trait can be demonstrated in its capacity to deploy brigade assets in preparation for war, Army does not yet have the ability to adjust its training and career systems in response to climate change. Army has a developing appreciation of the strategic implications of climate change, but it has underestimated the disruptive effects of extreme weather events on its own people systems. For the most part, climate change has been treated either as a fringe issue that Army will adapt to organically or (as some still believe) a problem that will go away on its own. However, the effects of climate change will be far more wide reaching than has been appreciated so far. Climate change will impact training, posting cycles, career management, promotion, families and perhaps even recruiting and retention. It will outlast Army's reorientation towards littoral manoeuvre and acquisition of drones, combat fighting vehicles, reconnaissance vehicles, self-propelled artillery, breaching vehicles, assault bridges, and other temporal technological advances in the years ahead.

To maintain capability and prepare for conflict, Army will need to embed in its people systems mechanisms that support inherent responsiveness to climate disruption. Cancellations and delays of courses, promotions and postings are certain; therefore, rather than waiting for an extreme weather event to occur before response plans are developed, Army should proactively prepare for the inevitable. Concurrently, Army members need to become more aware of their individual vulnerability to climate-induced career disruption and the consequences of climate change for their lifestyle and that of their family. Ultimately and inevitably, regardless of the strategic impacts of climate change on national security, climate change will affect every Army member personally

and in ways that have not been comprehensively explored in strategic musings; the repercussions are imminent.

As the Army, and the ADF more broadly, grapples with the impacts of climate change, continued engagement and enhanced operability with Pacific partners will strengthen collective resilience and regional stability. Exchanging experiences and mitigation strategies with counterparts grappling with similar impacts has potential to contribute to both enhanced capability and wellbeing of personnel across the region.

About the author: Colonel Philip Hoglin, graduated from the Royal Military College, Duntroon, in 1994, having completed a Bachelor of Science (Honours) majoring in statistics. He completed a Master of Science in Management through the United States Naval Postgraduate School in 2004, graduated from the Command and General Staff College of the Armed Forces of the Philippines in 2006, and was awarded a Master of Philosophy (Statistics) through the University of New South Wales in 2012. He has been involved in workforce analysis since 2004, was the Director of Military People Policy from 2014 to 2017 and the Director of Military Recruiting from 2018 to mid-2020, and is currently a researcher in Workforce Strategy Branch, Defence People Group.

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Climate Change as a Cascading Risk Multiplier in the Pacific*

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*This article does not necessarily reflect the views of the Australian Government.

Introduction

The Pacific sits at the crossroads of twenty-first-century security. Geography, demography, and narrow economic bases intersect with climate change, transnational crime, and strategic competition. Against the backdrop of this context, Pacific island countries are too often cast as passive recipients of aid. In reality, they have repeatedly demonstrated resilience grounded in community networks and pragmatic leadership. However, resilience alone cannot offset risks that are continuous, concurrent, and cascading in nature.

For Pacific island countries, geography is both a strength and a vulnerability. Vast maritime zones underpin food security and revenue, yet distance inflates infrastructure and security costs. Small, youthful populations generate employment pressures that domestic markets struggle to meet, entrenching reliance on labour mobility and remittances. That income is vital, but it also exposes Pacific island countries to external economic cycles and illicit financial flows. Economic concentration, such as in tourism, fisheries, or a single commodity, amplifies the impact of shocks.

Climate change is the existential accelerator. Sea-level rise, stronger and more frequent cyclones, and ocean warming strain public finances, damage law enforcement and defence infrastructure, and disrupt food systems. In the Pacific context, 'enforcement' encompasses the full spectrum of state authority at sea and on land—from fisheries patrols and customs interdiction to the policing of environmental and financial crimes. It is not confined to defence activity but represents the practical expression of sovereignty: the ability to uphold laws, protect resources, and deter external interference.

In the law enforcement (land and maritime) and regulatory compliance gaps that follow disasters, illegal, unreported, and unregulated fishing expands; illicit timber and wildlife trades flourish; drug traffickers test new maritime routes. These activities erode governance, foster corruption, and exacerbate vulnerabilities. Strategic competition compounds the challenge as external powers court influence with infrastructure, finance, and security partnerships, narrowing policy autonomy unless governance safeguards keep pace.

This paper adopts a continuous, concurrent, and cascading risks lens. Continuous risks persist, including climate pressures, Illegal, Unreported and Unregulated (IUU) fishing, organised crime, and corruption. Concurrent risks collide, disaster response alongside elections, budget crises, and border management. Cascading risks amplify one another. A cyclone closes a port, patrols pause, IUU fleets move in, revenues decline, emergency borrowing increases, and foreign influence and corruption exploit the stress. The result is an accelerating feedback loop that no single agency, or country, can manage in isolation.

Most Pacific island countries can manage discrete shocks. The challenge is their overlap under climate change. Applying this framework, the paper examines fisheries security, resource governance, transnational crime, migration and remittances, and institutional resilience. The argument is direct: climate change multiplies every other pressure. Local adaptation is essential, but it is insufficient without global mitigation.

The conclusion is practical and positive. The South Pacific Defence Ministers' Meeting (SPDMM) can anchor a regional shift to compound resilience, investments and arrangements that deliver simultaneous benefits across sectors. Priorities include climate-hardened, dual-use infrastructure that preserves patrol capacity during disasters; interoperable maritime domain awareness and shared watchfloors to close enforcement gaps; pre-negotiated surge agreements to maintain a minimum maritime presence in crises; and governance integrity measures, transparent procurement, anti-corruption safeguards, and financial crime controls to protect sovereignty. With an agency, partnerships, and a systems lens, the Pacific can convert resilience from a coping mechanism to a strategic advantage.

The Theory of Continuous, Concurrent, and Cascading Risks

Traditional approaches to risk management too often isolate threats into neat institutional categories: cyclones are managed by emergency agencies, fisheries by maritime enforcement, corruption by governance bodies, and organised crime by law enforcement. These frameworks may be helpful in bureaucratic organisations, but they fail to capture the lived reality of Pacific states. Risks in the region are rarely discrete; they are overlapping, compounding, and dynamic. The operating environment for governments and communities alike is characterised by risks that are continuous, concurrent, and cascading.

Continuous risks are those that persist over time. Climate change is the most obvious: rising seas, warming oceans, and more frequent extreme weather events (IPCC, 2022). Illegal, unreported, and unregulated (IUU) fishing is another. It does not appear sporadically, but rather as a sustained pressure, fluctuating with fuel costs, global demand for tuna, and enforcement capacity (FFA, 2022). Organised crime also endures, adapting routes but maintaining steady flows of cocaine and methamphetamine to meet Australian and New Zealand demand (UNODC, 2023). These examples demonstrate that the Pacific confronts not short bursts of risk, but long-term structural challenges that persist and never fully recede.

Concurrent risks emerge simultaneously, forcing governments to respond on multiple fronts at once. Pacific administrations are small and resource-constrained, with ministries often led by officials who hold multiple roles. When a cyclone strikes Fiji or Vanuatu, the same staff responsible for disaster relief may also be tasked with coordinating aid, managing the economy, and enforcing law and order. In Solomon Islands, major flooding in 2014 coincided with national elections, stretching institutions beyond capacity. During the COVID-19 pandemic, states faced the simultaneous burdens of border closures, remittance shocks, natural disasters, and disinformation (DFAT, 2021). Each would have been formidable alone; together, they forced complex trade-offs.

Cascading risks are the most dangerous, as they demonstrate how one shock can trigger second- and third-order effects that amplify the original crisis, thereby exacerbating it. A cyclone that

disables a port not only creates a humanitarian emergency but halts patrol resupply, opening fisheries to IUU fleets. The lost revenue fuels fiscal stress, forcing governments into emergency borrowing, often on unfavourable terms. This dependence increases vulnerability to external influence. Migration accelerates, hollowing out institutions, while rising remittances expand exposure to money laundering (ADB, 2022; ASPI, 2023). Each link reinforces the next, amplifying the disaster's impact beyond its initial scope.

The cumulative effect is a region under constant stress. Unlike traditional models that assume periods of recovery between crises, the Pacific reality is overlapping shocks and enduring vulnerability. Recognising risks as continuous, concurrent, and cascading reframes the Pacific security debate. It shifts the narrative from fragility to agency: Pacific states are not passive victims but resilient actors facing systemic pressures. It positions climate change not only as an environmental threat but as the great accelerant of risk. It underscores governance as the central fault line upon which sovereignty depends. It highlights that while Pacific states can adapt and respond, they cannot halt climate change on their own. For partners, the challenge is to support Pacific agency with strategies that address interconnected risks, not isolated problems.

Climate Change as an Existential Threat and Accelerant

Climate change is the defining existential challenge of our age, and nowhere is this more visible than in the Pacific. Rising seas threaten to erase entire nations, placing the very concept of sovereignty under pressure. For countries such as Kiribati and Tuvalu, the prospect of losing habitable land is no longer abstract; it is a looming reality that necessitates difficult choices regarding migration, maritime boundaries, and national identity (IPCC, 2022). Intensifying cyclones repeatedly devastate infrastructure across Fiji, Vanuatu, and Solomon Islands, forcing governments into cycles of response and recovery that erode fiscal stability and delay longer-term investment. Salinization steadily undermines agriculture in atoll states, while ocean acidification threatens coral ecosystems that underpin fisheries and tourism (BOM & CSIRO, 2023). These direct impacts alone would be sufficient to justify describing climate change as existential, but they do not capture the full strategic significance of the issue.

The most important dimension of climate change is its role as an accelerant of other risks. It does not create corruption, crime, or food insecurity on its own, but it exacerbates and intensifies their effects. Each climate shock creates fiscal gaps that external actors can exploit through opaque loans or aid-for-influence arrangements (ASPI, 2022). Each period of infrastructure damage (for example, ports and wharves) generates enforcement vacuums, which in turn allow IUU fishing fleets to expand their incursions (FFA, 2022). Each agricultural disruption increases reliance on imported food, creating exposure to price volatility and smuggling, and potentially a rise in black and grey markets. In this way, climate change amplifies vulnerabilities across economic, governance, and security domains simultaneously.

Climate change also reshapes the regional political economy of natural resources. Rising global demand for protein is placing unprecedented value on Pacific fisheries. As tuna migrate further offshore due to ocean warming, artisanal fishers are left with declining catches, while industrial fleets compete more aggressively in contested waters. Each cyclone or flood that reduces patrol capacity creates an opening for IUU operators. The result is not only a loss of revenue but a direct challenge to state sovereignty over maritime domains (FAO, 2024).

At the same time, climate change drives human mobility. Rising seas and declining agricultural viability create migration pressures, particularly to Australia and New Zealand under labour mobility schemes. While remittances generated through migration provide vital household income, they also hollow out domestic institutions by drawing away skilled professionals. The result is weakened capacity in health, policing, and education —precisely the sectors most needed to respond to the compounding crises (World Bank, 2023).

For these reasons, climate change in the Pacific cannot be understood as a discrete environmental issue. It is a strategic risk multiplier that interacts with, accelerates, and amplifies all other challenges. The cascading consequences extend across governance, security, and economic domains, eroding sovereignty and undermining stability. Pacific states can and do demonstrate resilience, but resilience alone cannot offset the accelerating pace of climate change-induced shocks. Without global mitigation, adaptation will always lag. For SPDMM, the imperative is clear: climate change must be framed not only as a humanitarian or environmental issue, but as the central security challenge shaping the region's future.

Solomon Islands: Fisheries and Sovereignty

For Solomon Islands, fisheries are not simply an economic asset; they are the foundation of community well-being and national sovereignty. Subsistence fishing underpins food security for rural households scattered across more than 900 islands, providing a vital source of protein in places where alternative sources are scarce or unaffordable. At the same time, tuna license fees and access agreements account for a significant share of government revenue, enabling the delivery of essential health, education, and infrastructure services. In short, the sea feeds both the people and the state.

Yet this reliance makes the country acutely vulnerable to shifts in the marine environment. As ocean temperatures rise, tuna stocks are moving farther offshore and, in some cases, beyond the exclusive economic zone (EEZ) of Solomon Islands. For artisanal fishers, this means longer journeys, greater costs, and lower catches. For the government, it means reduced leverage in negotiations with distant-water fishing nations, as the location of the resource becomes less predictable. What was once a relatively secure source of revenue and sustenance is increasingly volatile, buffeted by forces well beyond local control.

Illegal, unreported, and unregulated (IUU) fishing magnifies this problem. Foreign fleets, sometimes operating under license, sometimes not, exploit enforcement gaps to harvest tuna without declaring their catches or paying the required fees. The Forum Fisheries Agency estimates that IUU losses in the Pacific exceed US$600 million annually, with the Solomon Islands among the most affected. These losses are not just financial abstractions; they represent foregone school buildings, underfunded clinics, and reduced patrol capacity. In effect, every unreported tonne of tuna caught is a direct erosion of Solomon Islands' sovereignty and its ability to provide for its citizens.

Climate shocks further exacerbate the challenge. When cyclones strike, patrol boats are often diverted to humanitarian assistance and disaster relief. Ports may be damaged, fuel diverted, and communications disrupted. These operational pauses create windows of opportunity for IUU fleets

to increase incursions, knowing that enforcement capacity is reduced. Thus, what begins as an environmental disaster cascades into an economic and sovereignty challenge.

The second-order effects of these pressures are significant. Reduced revenues undermine fiscal stability, forcing governments into difficult choices between essential services. Weak enforcement emboldens illegal operators, creating a perception of impunity. Communities that experience declining catches face nutritional stress and are more susceptible to external inducements, whether from logging companies, foreign fishing operators, or political actors offering short-term benefits. The third-order effects are still more concerning: persistent fiscal stress creates openings for corruption, foreign influence, and the erosion of governance integrity.

These dynamics also have profound implications for regional stability. Solomon Islands' fisheries are not only national resources but part of a wider Pacific commons. Weakness in one EEZ affects the resilience of the whole system. When Solomon Islands struggles to monitor its waters, pressure shifts to neighbouring states, undermining collective efforts at sustainable management. Sovereignty, in this sense, is both national and regional: a chain only as strong as its weakest link.

In this environment, fisheries enforcement becomes more than a technical function; it is a test of a state's sovereignty. The ability to control and sustainably manage resources is the essence of sovereignty. For Solomon Islands, the contest over tuna is therefore not simply about economics but about the legitimacy of the state itself. When fleets fish illegally and go unpunished, it signals weakness; when the government can enforce its laws, it asserts independence.

The lesson is clear. Addressing fisheries challenges in Solomon Islands cannot be reduced to better patrol boats or new licensing agreements alone. It requires recognising the interconnected nature of climate change, IUU fishing, and governance capacity. It requires investments that build resilience across multiple fronts simultaneously: climate-hardened ports, interoperable maritime domain awareness systems, transparent revenue management, and stronger community engagement in fisheries governance. Only through such compound resilience can Solomon Islands secure its fisheries and, with them, its sovereignty.

Fiji: Resilience and Enforcement Gaps

Fiji has long been seen as one of the most resilient states in the Pacific, a reputation earned through its ability to withstand repeated climate shocks and political turbulence. Nevertheless, resilience comes at a cost. Cyclone Winston in 2016, one of the most powerful storms ever recorded in the Southern Hemisphere, devastated the islands' infrastructure, destroying homes, schools, and key public facilities. The government's immediate response was decisive, but reconstruction required enormous fiscal resources, diverting capital away from essential services, including education, health, and critical security functions such as maritime enforcement (ADB, 2022). Subsequent cyclones have arrived with shorter intervals, compressing recovery cycles and leaving little time for strategic investment.

One of the less visible but highly consequential outcomes of this cycle has been the impact on Fiji's maritime security capabilities. Patrol vessels and enforcement infrastructure require regular maintenance and predictable operational budgets. When resources are diverted to disaster recovery, these requirements are sidelined. After Winston, several patrol boats sat idle for extended

periods due to damaged wharves, lack of fuel, and competing fiscal priorities. During these windows, enforcement gaps widened, creating opportunities for illegal, unreported, and unregulated (IUU) fishing fleets to exploit Fiji's extensive exclusive economic zone (FFA, 2022). The consequence was not only lost state revenue but also reduced deterrence, which emboldened illicit actors.

The cascading effect extended beyond fisheries. Enforcement shortfalls also facilitated other forms of illicit activity. Smuggling routes became more active, with drugs and small arms moving through maritime corridors. Fiji has increasingly been identified as both a transit hub and a potential storage point for narcotics destined for Australia and New Zealand (UNODC, 2023). Each disaster, by pulling resources into humanitarian relief, indirectly created windows of opportunity for transnational crime. This demonstrates the broader thesis that climate change acts as a risk accelerator: natural disasters do not simply create humanitarian needs; they amplify vulnerabilities across multiple security domains.

At the community level, the effects of enforcement gaps are keenly felt. Coastal communities that rely on artisanal fishing often find themselves competing with industrial operators, both licensed and unlicensed, who can exploit weakened monitoring systems. The result is declining catches for households, higher food insecurity, and growing dependence on imported protein. This dependence exposes Fiji to external price volatility and further fiscal strain. In turn, households become more vulnerable to economic stress, a factor that can contribute to social tension and instability.

Strategically, Fiji's role as a regional leader means that neighbours and partners closely watch its resilience. Its ability to deploy forces for peacekeeping and regional security missions is a point of national pride, but the constant redirection of resources to disaster recovery risks eroding this role over time (ASPI, 2023). If Fiji's enforcement capabilities deteriorate, the entire regional security architecture is affected. Partners such as Australia, New Zealand, and France often provide surge support in the aftermath of disasters; however, this cannot substitute for a consistent domestic capability.

The lesson from Fiji is not that resilience is absent, but that resilience has limits. Each new cyclone adds to an accumulation of fiscal stress, institutional fatigue, and enforcement vulnerability. The cycle of recovery without sufficient time for consolidation is unsustainable. For SPDMM, the Fiji case highlights the importance of planning for continuity of enforcement during disasters, ensuring that humanitarian assistance and disaster relief (HADR) efforts do not compromise maritime sovereignty. Investments in climate-hardened infrastructure, pre-negotiated surge agreements, and interoperable maritime domain awareness platforms will be crucial to ensuring that resilience does not degenerate into fragility over the long term.

Vanuatu: Recovery Fatigue and Institutional Strain

Vanuatu exemplifies how repeated climate shocks generate cascading risks that erode state capacity over time. Cyclone Harold in 2020 devastated homes, schools, and transport infrastructure, forcing the government into another cycle of emergency response. Already stretched ministries diverted their limited personnel into disaster logistics, postponing governance reforms, anti-corruption initiatives, and fiscal planning. The constant redirection of attention away

from strategic priorities has created institutional fatigue. This system is always in crisis mode, rarely able to consolidate its recovery before the next disaster strikes.

This cycle also reshapes the state's political economy. As donor funds become the primary source of reconstruction finance, domestic priorities are crowded out, and the balance of policymaking tilts toward external partners. While external assistance is indispensable, dependence can reduce autonomy and create opportunities for influence that may not align with local needs and priorities. Second-order effects emerge quickly: procurement processes bypass due diligence under pressure, opening avenues for corruption and opaque contracting. The urgency of response overrides safeguards, embedding risks into governance.

The third-order effects are more corrosive. Communities, accustomed to repeatedl shocks and prolonged recovery, lose confidence in the government's ability to deliver services fairly and effectively. This declining trust erodes social cohesion, weakens the legitimacy of state institutions, and risks pushing more citizens toward reliance on external actors or informal networks. Over time, recovery fatigue does not just exhaust financial resources; it hollows the very institutions required for resilience.

Vanuatu's experience demonstrates that resilience cannot be measured solely by response capacity. Without space for reform and consolidation, each new disaster compounds existing fragilities. For regional partners, the lesson is clear: investments must help build institutional breathing space, climate-hardened infrastructure, pre-planned surge support, and governance safeguards to prevent resilience from becoming fragility.

Papua New Guinea: Timber, Corruption, and External Leverage

Papua New Guinea (PNG) possesses some of the world's most valuable remaining tropical forests; however, its forestry sector has become a textbook case of cascading risks, linking environmental crime, corruption, and external influence. For decades, illegal logging has flourished under the cover of opaque concession agreements, limited regulatory oversight, and foreign bribery. Billions of dollars in timber are exported annually, yet the benefits for local communities are minimal. Instead, the profits are captured offshore, leaving behind environmental degradation and social dislocation.

Wildlife trafficking often piggybacks on the same supply chains, embedding organised crime networks deeper into PNG’s economy. Timber shipments become convenient vectors for smuggling exotic species, creating overlapping risks that extend beyond environmental loss. Climate change magnifies these dynamics: as deforestation reduces biodiversity and damages watersheds, communities become more vulnerable to floods, droughts, and soil erosion. Scarcity further incentivises unsustainable extraction, creating a vicious cycle.

Second-order effects include entrenched corruption. Logging revenues have been used to finance political campaigns, undermining governance integrity and concentrating power in the hands of elites. Foreign companies and financiers, often from Asia, exploit this governance vacuum to secure long-term leverage, embedding themselves not only in the forestry sector but also in the political decision-making process.

Third-order effects are strategic. Environmental crime cascades into sovereignty risks, as foreign actors acquire disproportionate influence over PNG's domestic policies. What begins as a resource issue evolves into a challenge to governance, stability, and national independence. For PNG, forestry is no longer just about timber; it is about whether the state can defend its sovereignty in the face of compounding pressures.

For SPDMM, the Papua New Guinea experience highlights the need for an integrated security approach that views environmental crime not as a marginal issue, but as a direct threat to sovereignty and regional stability. Lessons from Fiji's governance reforms and maritime enforcement initiatives demonstrate the value of coordinated whole-of-government responses and shared intelligence frameworks. For PNG and its SPDMM partners, this means embedding environmental security within regional defence cooperation, strengthening maritime domain awareness, expanding joint patrols, and building institutional resilience against corruption and external interference that exploit resource sectors.

Tonga: Migration, Remittances, and Fragility

Tonga exemplifies the paradox of labour mobility in the Pacific. On one hand, migration is a critical source of resilience. Remittances account for more than a third of Tonga's GDP, serving as a buffer against economic shocks and providing a steady stream of income that supports education, healthcare, and daily consumption (World Bank, 2023). Seasonal labour schemes in Australia and New Zealand provide Tongans with valuable opportunities to earn higher wages abroad and send money back home. For many families, remittances are a lifeline that underpins social stability.

Yet this very reliance on migration creates significant vulnerabilities. The outward flow of skilled workers hollows domestic institutions. Teachers, nurses, and police officers frequently seek opportunities overseas, leaving gaps in Tonga's core public services. For a small state with limited human capital to begin with, the departure of even a few dozen professionals has a disproportionate impact on institutional capacity. Hospitals struggle with staffing, schools face shortages, and security services are forced to recruit less experienced personnel. The long-term consequence is institutional thinning, a slow erosion of capacity that undermines the state's ability to respond to crises.

Remittances also bring risks beyond economic dependence. While they strengthen household resilience, they create exposure to illicit financial flows. Money transfer systems can be exploited for money laundering or used to conceal proceeds of crime, particularly as financial transactions grow in volume and complexity. For Tonga, where financial oversight institutions are small and resource-constrained, this creates challenges in meeting international compliance standards and protecting the integrity of the financial system (UNDP, 2022).

Climate change accelerates these dynamics. Rising seas and extreme weather events threaten agricultural production and habitability, increasing the pressure on Tongans to seek opportunities abroad. Each cyclone or flood that disrupts livelihoods at home adds to the push factors for migration. While remittances rise in the short term, the domestic impact is a further weakening of institutions that are already stretched thin. The cascade is fiscal fragility, institutional hollowing, and increased exposure to financial crime.

Tonga's experience demonstrates that migration and remittances cannot be understood solely as sources of resilience. They are double-edged—essential to household survival but risky for state sovereignty and governance. For policymakers, the challenge is to design labour mobility schemes that balance remittance benefits with reinvestment in domestic capacity. Without such measures, Tonga's economic resilience risks becoming institutional vulnerability.

For SPDMM, Tonga's experience offers important lessons on the intersection of economic security and sovereignty. Labour mobility and remittance flows, while stabilising in the short term, can hollow out state capacity and deepen dependency if not paired with reinvestment in national skills and institutions. Fiji's efforts to channel remittances into local enterprise development and education offer a useful model for striking a balance between resilience and autonomy. Embedding these insights into regional security dialogues would allow SPDMM partners to anticipate and manage the strategic risks that arise when economic lifelines become vectors of vulnerability.

Second- and Third-Order Effects across the Region

The Pacific case studies demonstrate that the most serious consequences of climate change and external pressures are rarely found in the immediate, visible damage. Instead, they emerge through second- and third-order effects that ripple across societies, institutions, and economies. A cyclone that destroys a port or airfield, for example, does not just create an urgent humanitarian crisis. It disables maritime infrastructure, grounds patrol vessels, and reduces the state's ability to police its waters. These enforcement vacuums are quickly exploited by distant-water fleets, which intensify incursions into national exclusive economic zones. The result is not only the erosion of sovereignty but also the depletion of food security, as local communities lose access to fisheries they depend on for daily nutrition (FFA, 2022).

As revenues decline from lost licensing fees and disrupted trade, governments are forced into emergency borrowing. These fiscal pressures often come with strings attached, whether in the form of high-interest commercial loans or concessional finance linked to external strategic objectives. In both cases, the state's policy autonomy narrows, and opportunities for foreign influence expand. Second-order effects, therefore, include fiscal fragility and governance erosion, conditions that can persist long after the initial disaster has faded from international headlines (ADB, 2022).

The third-order effects are even more corrosive. Economic stress fuels corruption as urgent procurement decisions bypass oversight systems. Political elites, faced with fiscal shortfalls, may turn to external actors offering quick fixes, embedding foreign influence into domestic decision-making processes (ASPI, 2022). At the community level, declining opportunities at home accelerate migration, particularly through labour mobility schemes. While remittances provide essential household income, they also increase dependence on external labour markets and create vulnerabilities to illicit financial flows and money laundering (World Bank, 2023).

Meanwhile, thinning enforcement capacity allows organised crime groups to diversify their activities. Drug traffickers use Pacific routes more aggressively, exploiting both geography and reduced patrols to move consignments of cocaine and methamphetamine toward Australia and New Zealand (UNODC, 2023). Each disaster, therefore, becomes more than a climate event; it is a catalyst that cascades through food security, fiscal policy, governance, migration, and organised crime.

Taken together, these second and third-order effects illustrate why the Pacific's security challenges cannot be understood as isolated issues. They are interlocking and mutually reinforcing. Unless addressed through strategies that build compound resilience, investments and reforms that strengthen multiple sectors simultaneously, Pacific states risk being trapped in a cycle where each shock accelerates the next.

Transnational Crime: Drugs and Trafficking

The Pacific lies at the intersection of global supply and demand for narcotics, making it an increasingly significant corridor in the international drug trade. Overproduction of cocaine in the Americas and methamphetamine in Asia ensures a steady flow of supply. On the demand side, Australia and New Zealand represent lucrative markets, with retail prices for cocaine and methamphetamine among the highest in the world (UNODC, 2023). This imbalance between oversupply and high-value demand creates powerful incentives for traffickers to innovate and diversify routes. The Pacific's vast, sparsely patrolled waters, dotted with small states, make it an attractive transit zone.

Enforcement successes in Fiji and Tonga, where large shipments have been intercepted in recent years, demonstrate both the vigilance of local authorities and the scale of the challenge. However, for every high-profile seizure, multiple shipments likely pass undetected. Climate shocks exacerbate this vulnerability. Each cyclone that disables ports, radar systems, or patrol vessels creates enforcement gaps. Traffickers, highly adaptive and well-resourced, are quick to exploit these windows of reduced oversight. The cascade is stark: climate shocks weaken maritime surveillance, which in turn opens new trafficking routes, fuelling corruption and criminal activity onshore.

The consequences are not confined to transit dynamics. Increasing volumes of narcotics moving through Pacific states create risks of domestic spill over. While most consignments are intended for Australia or New Zealand, some product inevitably enters local markets. This fuels public health problems, strains policing capacity, and exposes small communities to criminal violence. In Fiji, for example, local law enforcement has raised concerns about the growth of domestic methamphetamine use linked to transit flows (ASPI, 2023). Small states with limited treatment facilities and stretched police services are poorly equipped to handle such challenges.

The financial dimensions are equally significant. Large-scale drug trafficking generates proceeds that must be laundered. In Pacific jurisdictions with small financial sectors and limited regulatory oversight, this introduces substantial risks of illicit financial flows. Informal remittance systems can be exploited for money laundering, and limited anti-money laundering compliance undermines global trust in local banking systems (UNDP, 2022). The result is a corrosive cycle: trafficking weakens enforcement, spills over to increase domestic crime, and illicit finance undermines governance.

For Pacific leaders and their partners, the challenge is not simply to interdict shipments but to recognise drug trafficking as part of the broader pattern of continuous, concurrent, and cascading risks. Climate shocks create enforcement vacuums, corruption enables trafficking networks, and foreign demand ensures profitability. Without compound resilience—investment in surveillance, governance, and financial integrity, the Pacific will remain exposed to the global drug trade.

Comparative Insights

The challenges facing the Pacific are not unique, though their intensity and scale often appear sharper due to the region's geography and demography. Other parts of the world provide instructive lessons on how continuous, concurrent, and cascading risks manifest, and how resilience can be strengthened or undermined.

The Caribbean offers one striking comparison. Like the Pacific, it is composed of small island states exposed to frequent and destructive hurricanes. Each major storm not only devastates infrastructure but also fuels organised crime. When ports and airports are damaged, law enforcement is diverted to humanitarian response, opening enforcement vacuums. Traffickers exploit these gaps, moving narcotics into North America and Europe. In places such as Jamaica and the Dominican Republic, the cycle of natural disaster, fiscal stress, and organised crime has become self-reinforcing (UNODC, 2023). This mirrors the Pacific experience, where cyclones weaken maritime patrol capacity and open corridors for drug trafficking and illegal fishing.

Southeast Asia provides another parallel. The region has long struggled with illegal, unreported, and unregulated (IUU) fishing, which erodes governance, undermines food security, and generates significant opportunities for corruption. Countries such as Indonesia and the Philippines have invested heavily in maritime enforcement and legal reforms, with mixed results. Their experience underscores a critical lesson for the Pacific: enforcement alone is insufficient. Without governance reforms, transparency in licensing, and community engagement, IUU fishing adapts and persists (FAO, 2024). For Pacific island countries, which lack the scale of Southeast Asian states, compound approaches that integrate enforcement with governance and community development will be essential.

Northern Australia also offers a useful comparative lens. While not a small island state, it shares key characteristics with the Pacific: remoteness, fragile infrastructure, and high exposure to natural hazards. Cyclones and floods regularly disrupt supply chains, exposing vulnerabilities in critical infrastructure. The Australian government has responded with climate-resilient investments, including elevated roads, upgraded ports, and resilient energy systems (ASPI, 2022). These measures serve not just local communities but also enhance national security by ensuring continuity of operations across defence and economic domains. For the Pacific, the lesson is clear: investments must deliver benefits across sectors simultaneously. Infrastructure designed solely for one purpose—such as ports that serve only commercial shipping—misses the opportunity also to support humanitarian responses, fisheries enforcement, and defence operations.

Comparative cases, therefore, confirm that resilience must be compound. Investments in climate-hardened infrastructure, interoperable maritime surveillance, and governance integrity generate dividends across multiple sectors at once. They reduce vulnerabilities not just to climate change but also to organised crime, corruption, and external coercion. For the Pacific, learning from the Caribbean, Southeast Asia, and Northern Australia demonstrates that resilience cannot be siloed; it must be systemic, integrated, and future-focused.

Implications for Defence and Security Cooperation

For SPDMM, the reality of continuous, concurrent, and cascading risks demands a sharper and more integrated security agenda. Defence cooperation in the region can no longer be confined to traditional notions of military capability. Instead, it must encompass the broader spectrum of resilience, ensuring that humanitarian deployments, maritime enforcement, governance integrity, and institutional capacity are mutually reinforcing rather than competing priorities.

When aligned with Australia's *National Defence Strategy (2024)*, the cascading impacts of climate change in the Pacific strengthen the argument for increased defence resourcing and sustained presence in the region. The NDS emphasises collective security and regional stabilisation; the SPDMM provides the platform through which these objectives can be operationalised. Climate adaptation in defence planning—through resilient infrastructure, regional logistics nodes, and coordinated maritime surveillance—should be recognised as force-multiplying investments that secure both national and regional interests.

A central implication is that humanitarian and disaster relief (HADR) deployments must not come at the expense of maritime enforcement. When patrol vessels are diverted to disaster response, enforcement vacuums are created that transnational crime and illegal fishing fleets are quick to exploit. Defence planning must therefore prioritise continuity of maritime presence during crises. This requires surge arrangements that are pre-negotiated and readily deployable, enabling regional partners to fill enforcement gaps when individual states are stretched.

Interoperability must also be redefined. It is not enough for forces to operate similar platforms; they must share data, analysis, and doctrine. Regional maritime domain awareness systems should be integrated, with secure channels for sharing intelligence and coordinating patrols. Exercises should test not only joint operations but also the ability to sustain concurrent missions, such as disaster relief and enforcement, without one undermining the other.

Existing mechanisms, such as the Pacific Response Group (PRG), already provide flexible architecture for coordinated HADR responses. Likewise, should it eventuate, the emerging Joint Heads of Pacific Security-led Regional Operations Deployment Framework could institutionalise these arrangements, enabling pre-positioned assets, shared logistics and rotation-based deployments that sustain presence even when individual states are responding to concurrent crises.

Defence cooperation must further acknowledge that governance erosion is as much a threat to sovereignty as external aggression. Anti-corruption measures, transparency in procurement, and oversight of security assistance are essential. Without these, external actors can leverage aid or infrastructure finance to embed their influence and reshape a country's strategic orientation.

Ultimately, the strategic agenda must be centred on compound resilience. Investments in climate-hardened bases, dual-use infrastructure, and interoperable patrol fleets will deliver benefits across humanitarian, economic, and security sectors simultaneously. For SPDMM, the imperative is clear: defence and security cooperation in the Pacific must be future-proofed against cascading risks, recognising that climate change is not only an environmental issue but the accelerant of every other threat the region faces.

Climate-induced security pressures also have profound implications for the Women, Peace and Security (WPS) agenda. Disasters disproportionately affect women's livelihoods and security, increasing risks of gender-based violence, economic marginalisation, and exclusion from decision-making. Ensuring that WPS principles—participation, protection, and leadership—are integrated into regional resilience planning is crucial. SPDMM can play a leading role by promoting gender-responsive HADR operations, integrating female leadership into maritime enforcement, and ensuring that climate security strategies advance—not erode—gender equality across the Pacific.

The regional security architecture—anchored by the Boe Declaration, the Pacific Islands Forum, and SPDMM—can be further shaped to promote coherence across civilian, law enforcement, and defence domains. Coordinated planning cycles, shared early-warning systems, and regional training pipelines would help convert national efforts into a genuinely integrated Pacific security network, capable of managing cascading risks collectively rather than sequentially.

Conclusion

The Pacific stands at the frontline of the twenty-first century's most pressing security challenges, yet it is far from powerless. The theory of continuous, concurrent, and cascading risks reveals the complexity of the region's strategic environment, but it also clarifies the pathway forward. Pacific island countries are not merely passive recipients of aid or external attention; they are active, sovereign states that demonstrate remarkable resilience, innovation, and leadership. What they require is not sympathy, but partnership and collaboration that strengthen agency, build compound resilience, and future-proof institutions against accelerating pressures.

Climate change is the accelerant that intensifies every other threat, from illegal fishing to organised crime and corruption. But framing it solely as a crisis risks obscuring the opportunity it presents: the chance to invest in infrastructure, governance, and defence cooperation that deliver dividends across sectors. Climate-hardened ports, interoperable maritime domain awareness, and transparent governance systems are not simply adaptation measures; they are strategic investments in sovereignty and stability. They can allow Pacific states to turn vulnerability into strength, transforming resilience from a coping mechanism into a foundation for long-term security.

For SPDMM, the imperative is clear. Defence and security cooperation must be reimagined for an age of cascading risks. That means ensuring HADR operations do not hollow out maritime enforcement, embedding anti-corruption safeguards in assistance, and pre-negotiating surge arrangements that guarantee continuity in times of crisis. Most importantly, it means embracing compound resilience as the guiding principle: initiatives that simultaneously strengthen humanitarian response, economic security, governance integrity, and defence capability.

The Pacific has consistently demonstrated its ability to adapt to adversity. With the right partnerships and strategies, it can not only withstand the pressures of climate change and global competition but also emerge as a model for resilience in a turbulent world. The task now is to act with urgency, clarity, and resolve.

A future-proofed regional defence strategy—anchored in SPDMM, aligned with the NDS, and reinforced by the PRG—would ensure that Pacific resilience is not simply reactive but strategic, protecting sovereignty through collective preparedness and inclusive security.

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Implications of Climate Change for Maritime Security: A South Pacific Perspective with a Focus on Chile

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Abstract

Due to its location in the southeastern Pacific and its island territories, Chile naturally projects itself toward Oceania, the Asia-Pacific region, and Antarctica. This connects Chile to important ecosystems containing varied resources and vital maritime trade routes. However, this geopolitical reality is threatened by climate change, which poses an increasing and multifaceted risk to global maritime security, particularly in this region.

In recent years, scientific observations have confirmed an acceleration of phenomena such as rising sea surface temperatures, ocean acidification and deoxygenation, rising sea levels, and an increased frequency and intensity of extreme weather events, such as storm surges. These changes are interconnected, amplifying the vulnerabilities of marine ecosystems, coastal infrastructure, navigation, and supply chains.

The direct consequences of these changes cause significant damage to port infrastructure, disrupt shipping routes, and severely affect fishing and aquaculture, thereby compromising food security and coastal livelihoods. Beyond the physical impacts, climate change has profound socioeconomic and geopolitical repercussions, such as the displacement of coastal communities and the intensification of disputes over boundary changes or the scarcity of marine resources.

Despite being highly vulnerable to the effects of climate change, Chile has responded with a proactive regulatory and strategic framework that includes adaptive laws and regulations. The National Maritime Authority and the Chilean Navy play an important role in this framework by actively integrating climate considerations into their operational planning and collaborating in regional and international forums. Nevertheless, the scale and pace of climate change require the continuous reassessment and strengthening of these strategies to promote an adaptive, interdisciplinary, and collaborative approach.

Introduction

This article addresses the problems that climate change poses for maritime security from the Chilean perspective. To this end, it analyzes various aspects, considering the responses and actions that the country has taken in the face of these climate challenges and proposing some recommendations to strengthen resilience and adaptation to this global phenomenon.

Climate change has become one of the most pressing phenomena of the 21st century, progressively transforming the maritime security landscape into a global concern. Far from being a future threat, its effects are already evident and accelerating, with direct implications for infrastructure,

operations, resources, and the socioeconomic stability of coastal and oceanic areas, particularly in the South Pacific.

According to the World Meteorological Organization (WMO), in 2024, the global average surface temperature was 1.55 degrees Celsius, above the existing average, making it the warmest year on record in 175 years, surpassing 2023, which saw an increase of 1.45 degrees Celsius above the average. The last ten years, between 2015 and 2024, have been the warmest years on record globally (World Meteorological Organization [WMO], 2025).

A key element in understanding this dynamic is the renewing role played by the oceans. These vast bodies of water act as a vital buffer for the global climate system, absorbing approximately one-third of carbon dioxide emissions and 90% of the excess heat generated by these emissions (Undersecretary for the Armed Forces [SSFFFAA], 2024). This absorption capacity, while mitigating atmospheric warming, leads to profound internal transformations in the oceans, such as warming and acidification. These oceanic alterations are, in turn, the main drivers of a cascade of disruptions that directly affect marine ecosystems, coastal facilities, and navigation, impacting maritime security. The relationship between ocean absorption and its consequences for maritime safety is a critical causal interdependence: the solution to one problem (atmospheric warming) creates new and complex challenges in another domain.

The South Pacific region, characterized by its vast oceanic expanse and the presence of numerous island and coastal states, is particularly susceptible to these changes. Chile, with its vast coastline, island territories, and extensive maritime areas, ranks eleventh in the world in terms of square kilometers of Exclusive Economic Zone (it has a coastline of 6,435 km in length and an Exclusive Economic Zone of 3,681,989 km²). This geography makes it a maritime nation par excellence, where security and the proper use of the sea are ongoing challenges for the State, and their protection is a true national objective. This mission is carried out by the Chilean Navy, through the Maritime Territory and National Merchant Marine Directorate (DIRECTEMAR) as the national maritime and authority, which remains on permanent alert, aware of the implications of this reality (see Figure 1).

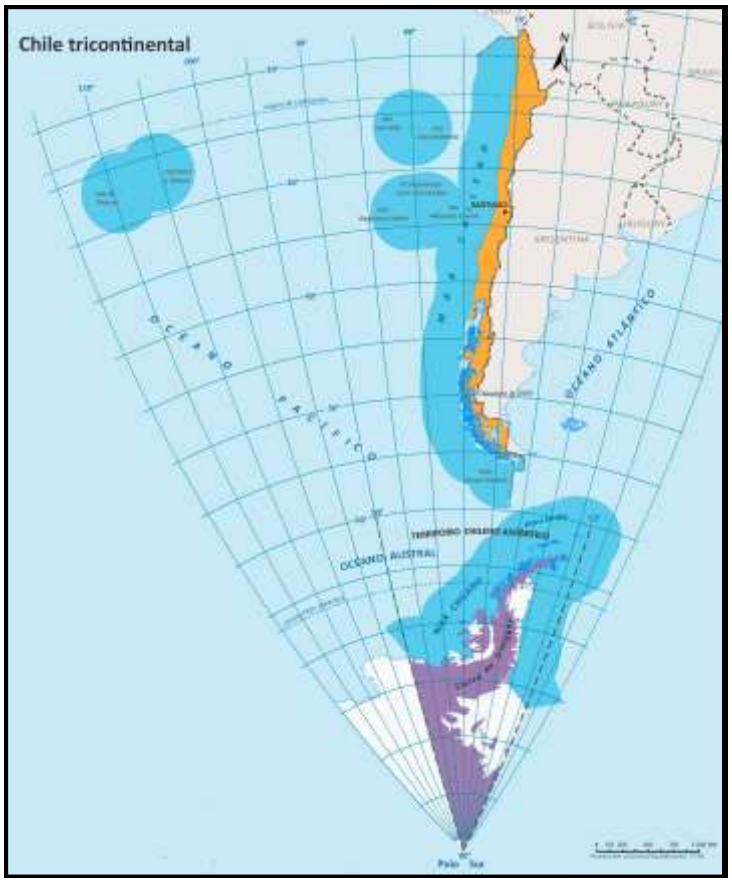

Figure 1: Tri-continental Chile

(Source: Chilean National Defense Policy 2020)

Chile's vital dependence on the sea means that changes in the marine environment are not distant threats, but direct challenges to its development, economy, and security. In this sense, the effects of climate change are not mere environmental concerns, but directly impact the ability to manage its maritime territory and protect its interests. Therefore, the permanent readiness of the Navy underscores that it must be prepared to act, because the magnitude and speed of climate impacts indicate that traditional security paradigms are insufficient, requiring a more dynamic and adaptive approach.

This elevates climate change from an environmental concern to a fundamental issue for Chilean national security, given that the country meets seven of the vulnerability criteria established by the United Nations Framework Convention on Climate Change, highlighting the presence of low-lying coastal areas. Given its dependence on maritime activities for trade, resources, and livelihoods, it is inherently vulnerable to the multifaceted impacts of climate change in its maritime domain (SSFFFAA, 2024).

Manifestations of Climate Change in the South Pacific

By absorbing a significant portion of excess heat and carbon dioxide from the atmosphere, the ocean undergoes physical and chemical transformations that have direct and profound consequences for the marine environment. These phenomena do not occur in isolation, but interact and amplify each other, creating a complex system of threats to maritime security, the following effects being particularly noteworthy:

- **Increase in sea surface temperature and marine heat waves**

  The Pacific Ocean has not been spared from high surface temperatures. More specifically, the southwestern Pacific has shown particularly rapid ocean surface warming trends (World Meteorological Organization [WMO], 2025). According to the same source, marine heatwaves reached unprecedented intensity and duration in 2023, breaking records in terms of extent and persistence. These temperature rise events are directly linked to mass mortality of marine species, significant alterations to marine habitats, and serious negative impacts on fisheries and aquaculture (Science told in Spanish [SINC], 2025). In addition, rising sea temperatures have other effects on the ocean that further stress marine ecosystems, forcing species to move from their traditional habitats (Ministry of the Environment [MMA], 2021).

- **Ocean acidification and deoxygenation**

  The continuous absorption of atmospheric CO2 by the oceans causes the acidification of seawater, a process that fundamentally alters marine chemistry and negatively affects various living organisms (MMA, 2021). This process is known to exacerbate the negative effects on critical marine resources, including fish and shellfish that are commercially important for human consumption. In addition to acidification, warming ocean waters directly contribute to a reduction in dissolved oxygen levels, a phenomenon known as deoxygenation, which disrupts the balance of marine ecosystems by causing displacement, decline, or even extinction of native species (US Environmental Protection Agency [EPA], May 21, 2025).

- **Sea level rise**

  The average sea level has risen by an average of 3.3 ± 0.3 mm per year between 1993 and 2022, accumulating a total increase of 9.57 cm during this period, confirming that the rate of increase has accelerated, almost doubling to 4.5 mm/year between 2011 and 2020 (Copernicus Maritime Service [CMEMS], n.d.). This accelerated sea level rise poses a growing threat to coastal areas around the world, but particularly for the so-called Small Island Developing States (SIDS) in the South Pacific, such as Tuvalu, Kiribati, and Fiji. These countries face exceptional vulnerability to the impacts of climate change due to a combination of geographical, economic, and environmental factors, in which their low elevation above sea level makes them particularly susceptible to sea level rise.

  Indeed, regional variations in this rise are significant; for example, the El Niño-Southern Oscillation phenomenon can cause sea level changes of up to 30 cm in the low-lying Pacific islands, highlighting the importance of localized projections (CMEMS, n.d.). For the coastal zone of Chile, projections indicate an increase in flood levels ranging from +0.23 to +0.29

meters in the southern and northern extremes, respectively, which, projected over the long term, implies significant effects on coastal infrastructure (Ministry of the Environment [MMA], 2019).

The consequences of this increase are complex, as they involve greater coastal erosion and the intrusion of salt water into habitable areas, directly threatening coastal communities and areas vital for food production.

- **Increase in the frequency and intensity of extreme weather events**

  Intense weather events are expected to become more frequent and severe in the near future. In the case of Chile, the country has already experienced a notable increase in the frequency and intensity of storm surges, which are now considered a persistent feature of its coastline. These events have led to a significant increase in the number of port closures, particularly affecting port facilities in the main national ports (DIRECTEMAR, 2020). The combination of tides, waves, and storm surges, exacerbated by rising sea levels, contributes to more frequent extreme sea conditions along the coast.

  The concurrence and cumulative effect of these phenomena generate a constant synergistic threat, amplifying the overall impact on marine ecosystems and human activities. This creates an environment of multiple factors, each increasingly stressful, which complicates adaptation and mitigation efforts. Therefore, increasingly localized projections and the integration of dynamic oceanographic models are required to accurately assess the risks involved.

Direct implications for maritime safety

The impacts of climate change translate into direct and tangible implications for maritime safety and operations in the South Pacific, particularly in Chile, affecting economic, social, and environmental aspects, among which the following stand out:

- **Vulnerability and damage to port and coastal infrastructure**

  Coastal flooding, overflow due to sea level rise, and thermal stress from higher temperatures are the main factors that amplify risks to global port operations (Eslava, 2023). In Chile, climate change is projected to continue causing an increase in, storm surges, and sea level rise, which will have a significant impact on port infrastructure in the coming decades, as 19 of Chile's 28 main ports are open and directly exposed to the Pacific Ocean. For this reason, it is important to incorporate climate change projections into the improvement and modernization of ports, as well as into the design of all future port infrastructure, in order to improve their resilience and thus ensure their continued operation over time (Center for Integrated Disaster Risk Management [CIGIDEN], n.d.).

  This increased frequency and intensity of storm surges directly leads to port closures, affecting operations and causing downtime for various port activities. In this regard, the Chilean Navy anticipates direct impacts on coastal facilities, naval bases, and ports due to sea level variations (Martínez, 2018).

- **Risks to navigation, shipping routes, and vessel safety**

  Another factor to consider is the increased incidence of unsafe navigation conditions, driven by factors such as higher waves, tropical cyclones, and coastal flooding, which can cause accidents or significant delays in ship movements both entering and leaving ports, as well as affecting cargo stowage, contributing to an increase in the loss of containers overboard. This phenomenon creates direct hazards to navigation, as well as significant environmental and human risks, with an estimated 10,000 containers, equivalent to 41,500 metric tons of polluting steel, falling into the world's oceans each year (Eslava, 2023). This is in addition to other hazards to navigation such as changes in port depths, displaced ice banks, and changes in ocean currents, which may not be adequately reflected in current nautical charts.

  Another factor affecting ship safety is biofouling (the accumulation of marine organisms on ship hulls), which, in addition to increasing fuel consumption, can introduce invasive species into new habitats when they detach from the hulls, posing new environmental threats to native ecosystems (Eslava n.d.), which could further destabilize marine environments, potentially leading to new regulatory burdens, operational restrictions, and even legal liabilities for ships.

- **Impacts on marine biodiversity and coastal ecosystems**

  The combination of factors such as warming, deoxygenation, and acidification poses a significant and existential threat to numerous marine species, with widespread impacts on marine biodiversity and the fundamental behavior of all oceans. This is in addition to alterations in the hydrological cycle, such as increased salinization of freshwater sources and more frequent flooding events, which have a negative effects on freshwater habitats, causing irreparable damage to wetlands and springs and affecting the species that depend on them (DIRECTEMAR, 2021).

  Another effect on marine ecosystems is that, given the increase in sea temperatures, this directly leads to a greater presence of certain species in areas where they were previously less common, with changes in population and a redistribution of certain significant marine fauna being observed.

- **Impact on fishing, aquaculture, and marine food security**

  The changes described in marine biodiversity and ecosystems are causing a significant decline in the potential for sustainable fishing and aquaculture, leading to the emergence of new patterns of crime, which have been termed "blue crimes." These crimes are emerging as a risk to coastal communities facing these threats and complicating their livelihoods (Bueger, 2020).

  This occurs because variations in oceanographic conditions lead to unpredictable changes in fish abundance or mass migrations away from traditional fishing grounds, resulting in illegal, unreported, and unregulated (IUU) fishing. Especially in regions such as the South Pacific, where it is a growing threat, causing economic and environmental damage due to the inability of countries to fully monitor their Exclusive Economic Zone (EEZ). This leads to a decline in marine resources, creating a vicious cycle where climate impact undermines legitimate livelihoods, which in turn drives illegal activities, further degrading marine resources and challenging maritime governance and the rule of law (Food and Agriculture Organization of the United Nations [FAO], n.d.).

Socioeconomic and geopolitical dimensions of maritime security

The influence of climate change extends far beyond direct physical impacts, fundamentally reshaping socioeconomic landscapes and introducing significant potential for geopolitical instability within the maritime domain. The following phenomena are particularly noteworthy:

- **Displacement of coastal communities and migratory pressures**

  Globally, sea level rise is projected to expose many communities to permanent coastal flooding, leading to property losses in coastal areas and the loss of natural habitats, as well as potential loss of life. Another factor that is expected is an increase in involuntary migration resulting from this climate change-induced scarcity of resources, which is recognized as a growing concern for national security.

  In the case of Chile, the risks associated with climate change are exacerbated by explosive coastal occupation and development, including real estate, docks or land reclaimed from the sea, and industrial facilities, which amplifies the vulnerability of these regions (DIRECTEMAR, 2020).

  This direct and accelerated connection between climate impacts and human migration transforms climate change from a purely environmental concern to a critical human security imperative. This phenomenon can generate significant internal pressures within affected nations and create cross-border challenges, thus impacting broader regional stability and security dynamics.

- **Potential conflicts over marine resources and fishing grounds**

  Climate change fundamentally alters the distribution patterns of fish populations and their main food sources, leading to unpredictable changes in marine ecosystems and encouraging illegal, unreported, and unregulated (IUU) fishing. In addition, the increasing variability and transboundary movement of fish stocks greatly hinder effective management and agreement on catch limits between nations, creating fertile ground for disputes or conflicts. Climate change is thus increasingly recognized as a threat multiplier, indirectly increasing the risks of conflict, particularly in regions or countries characterized by weak democracies or pre-existing internal conflicts, which can intensify rivalry between states and potentially lead to new or exacerbated border disputes (Martínez, 2018).

  The pre-existing challenge of overfishing, when combined with the additional pressures of climate impacts, further exacerbates the difficulty of achieving sustainable marine resource management and increases the potential for conflict. This increased competition has the potential to escalate geopolitical tensions if not proactively managed through broad international cooperation and adaptive governance frameworks.

- **Impact on regional supply chains and maritime trade**

  Climate change also affects global supply chains due to disruptions in port logistics and maritime transport. Port infrastructure is vulnerable to flooding and extreme weather events, which can cause temporary closures or prolonged damage to ports. In this regard, delays in

ship arrivals and departures affect the synchronization of supply chains, increasing costs and causing product shortages.

Maritime trade is also influenced by climate effects, as increased risks and operating costs can lead to changes in trade routes and the choice of new ports, significantly raising freight costs. Similarly, as a result of initiatives to reduce greenhouse gas (GHG) emissions, several nations have promoted the adoption of cleaner technologies as well as the incorporation of stricter environmental regulations, affecting the operation and costs of maritime trade, which in turn impacts the supply chain. (Det Norske Veritas [DNV], 2023).

Another factor to consider is climate-induced hydrological changes, such as severe droughts that cause a decrease in the flow of major rivers, directly impacting navigation in ports and inland waters, as well as logistics, requiring costly interventions such as dredging. Similarly, the Panama Canal has experienced a substantial 20% reduction in ship traffic due to climate impacts (specifically drought affecting water levels), which has repercussions for maritime traffic. These impacts on port infrastructure and navigation are not mere localized incidents, but reveal a systemic vulnerability in the global maritime transport network, given that the significant reduction in traffic through critical convergence points such as the Panama Canal demonstrates how localized environmental changes can cause widespread disruptions in global supply chains, directly affecting national economies and international trade flows (Mendoza, 2024).

- **Change in maritime boundaries and borders**

Sea level rise caused by climate change poses a significant challenge to the delimitation of maritime boundaries, which are based on the United Nations Convention on the Law of the Sea (UNCLOS) and determined by coastal baselines that can change due to erosion, submersion, or coastal displacement. This physical loss of land, especially in island countries or countries with low-lying coastlines, could lead to the reduction or loss of sovereign areas by flooding areas that serve as the basis for maritime delimitation, directly affecting the basis from which maritime zones are calculated, such as the territorial sea, the Exclusive Economic Zone (EEZ), and the continental shelf, among others.

The effect of baseline displacement must be studied on a case-by-case basis to determine how to apply UNCLOS to adjust a new maritime boundary, particularly in the event of loss or modification due to natural causes, which could lead to legal claims and potential disputes between States. The same situation arises in the event of a claim, where a country could attempt to redefine its maritime boundaries based on new coastlines or land displacement, which would also lead to conflicts and complex negotiations.
In this sense, this phenomenon creates significant geopolitical challenges, including the risk of mass population displacement, humanitarian crises, and disputes over sovereignty and marine natural resources. For this reason, island countries and coastal states, particularly the most vulnerable, face threats that could eventually affect their sovereignty and territorial integrity, which could increase international conflicts and jeopardize regional cooperation. In response, it is necessary to adapt national and international legal frameworks, strengthen peaceful dispute resolution mechanisms, and promote interstate cooperation.

Chile's responses to maritime climate challenges

Chile has established a robust, multi-level regulatory and institutional framework that covers the legal, strategic, and operational spheres. To address the challenges posed by climate change in the maritime and coastal sectors, the following measures stand out:

Regulatory framework and national policies

- Chile has taken a leading position in climate action at the regional and global levels, demonstrating its ongoing commitment through the implementation of various initiatives and policies, as well as the presentation of its NDC, which stands for Nationally Determined Contributions, which are the national plans that each country presents to combat climate change. These plans detail how they will reduce their greenhouse gas emissions and how they will adapt to the impacts of climate change, with the aim of complying with the Paris Agreement and limiting global temperature rise (United Nations (UN) (n.d.). The first document of this type was published in 2020 and is currently being updated for presentation in 2025.
- Along with this, the enactment and implementation of the Framework Law on Climate Change (Law No. 21,455, 2022) stands out. This is considered historic legislation that requires the development of comprehensive long-term sectoral mitigation and adaptation plans to comply with the country's international commitments, particularly to limit global temperature rise. It also legally enshrines Chile's commitment to achieve carbon neutrality by 2050.
- Another important policy is the National Coastal Zone Use Policy, which is currently being updated to explicitly integrate climate change considerations and promote an integrated management approach for coastal ecosystems. This update includes the critical task of formally defining what constitutes the "Coastal Zone" in Chile for operational and planning purposes (SSFA, 2024).
- Chile's 2020 National Defense Policy also addresses climate change as a global concern, linking it to maritime security through the responsibilities and challenges it imposes on the defense sector. It recognizes that the Pacific Ocean is a major global source and reserve of natural resources and the main mitigator of atmospheric temperature increase, moderating climate change generated by human activity. This document establishes concrete actions for the defense sector to mitigate climate change, such as adapting infrastructure and doctrine, greater community support to counteract the effects of natural disasters and climate change itself, as well as greater enforcement and control of environmental regulations and monitoring of protected areas. (Ministry of National Defense [MDN], (2020). It should be noted that Chile's 2020 National Defense Policy is currently being updated, with the new version expected to be enacted in the final months of this year.
- Chile's National Green Hydrogen Strategy, enacted in November 2020, is a strategic national initiative aimed at achieving deep decarbonization in several sectors, taking advantage of the country's immense renewable energy potential. (Ministry of Energy [ME], 2020). In this regard, green hydrogen is a clean energy source with the potential to decarbonize sectors such as maritime transport, which represents environmental benefits by reducing polluting emissions. However, it poses challenges related to storage, handling, and flammability risks. Therefore, it is necessary to develop specific regulations, technologies, and protocols to ensure safety in its transport and use in the maritime sector. For this reason, the maritime authority

must establish the necessary protocols for safe and controlled use.

Initiatives of the Maritime Authority (DIRECTEMAR) and the Chilean Navy

- The Defense has specific responsibilities and obligations with regard to maritime spaces, including their control, surveillance, and the safety of persons, vessels, and maritime terminals, as well as the protection of the marine environment and its resources, and maritime and air connectivity to island territories. The National Maritime Authority, under the Chilean Navy, has the primary role of exercising police functions in its area of responsibility, which includes surveillance and control of activities in jurisdictional waters, prevention through the oversight of activities, and the capacity to respond to maritime incidents (MDN, 2020).
- In Chile, it is represented by the General Directorate of Maritime Territory and Merchant Marine (DIRECTEMAR), an entity that, in order to fulfill its mission in an exemplary manner, has implemented innovative projects aimed at reducing its own carbon footprint, demonstrating a tangible commitment to environmental management and public service. It also explicitly recognizes the compound nature of climate stressors—including warming, deoxygenation, acidification, and increased storm surges—as significant threats to marine biodiversity and the overall health of the world's oceans, indicating a comprehensive understanding of the challenge (DIRECTEMAR, 2021).
- In addition, the Maritime Authority, through its climate change office, which reports to the Directorate of Maritime Interests and Aquatic Environment (DIRINMAR), supports various ministries on technical issues related in some way to the maritime sphere and activities, as well as inter-institutional initiatives led by the Ministry of the Environment. In addition, it is the technical authority that guides institutional action for climate change adaptation and mitigation and, at the same time, must implement the measures adopted in international agreements relating to the maritime sector.
- From a strategic perspective, the Chilean Navy is constantly evaluating and proactively identifying the specific impacts of climate change on its operations and institutional responsibilities. This assessment is designed to inform and guide the implementation of relevant adaptation, mitigation, and management measures in all activities carried out, and is now a strategic variable in its naval operations planning. This includes planning, logistics, and training to carry out Humanitarian Assistance and Disaster Response operations, given the increased demand for this type of humanitarian mission, which requires rapid deployment of forces, reflecting a proactive approach to disaster response.
- HADR (Humanitarian Assistance and Disaster Relief) naval operations are missions in which naval forces support the rapid and efficient delivery of aid following natural disasters or emergencies. These operations include the deployment of resources for rescue, evacuation, and the provision of food, water, medicine, and medical equipment, as well as the restoration of critical infrastructure. Naval capabilities, such as access to affected coastal and maritime areas, mobility, and autonomy, make them essential for saving lives and mitigating the impact of disasters.
- Participation in international exercises is essential for training in this area, which is why the Chilean Navy is part of various bodies that enable such training. This has allowed it to strengthen coordination and cooperation between countries and agencies, optimize resources and response times, and identify deficiencies in protocols, doctrines, and command structures

in a timely manner, particularly in emergency situations, where rapid reaction is essential. These simulations allow for joint-combined training that improves the adaptability and preparedness of naval and maritime forces in the face of natural disasters, promoting the adoption of emerging technologies and new methodologies that strengthen inter-institutional relations, which is essential for providing a rapid and effective response to crises that transcend borders and affect vulnerable populations.

All these initiatives indicate national recognition of climate change as a central challenge to national security and development, going beyond mere environmental protection to incorporate adaptation and mitigation directly into strategic and operational decision-making in various government sectors, particularly the defense sector.

Regional and international collaboration

- Chile collaborates with the International Maritime Organization (IMO), a specialized agency of the United Nations that promotes cooperation between states and the transport industry to improve maritime safety and prevent marine pollution. Chile has been a member state of the IMO since 1972 and, since 2001, has been a member of the Organization's Council in Category C, which comprises 20 countries. It is currently applying for a new term from 2026 to 2027 (DIRECTEMAR, 2025). Membership of the IMO Council has enabled Chile to play a key role in multilateral discussions on issues such as maritime safety, marine environmental protection, and the relationship between oceans and climate change, in line with its national commitments on ocean and biodiversity protection.
- This active participation allows Chile not only to defend its specific regional interests and vulnerabilities, but also to influence the shaping of global norms and promote international cooperation, which are essential elements for addressing the inherently transboundary nature of climate-related maritime security challenges.
- A special forum is the South Pacific Defense Ministers' Meeting (SPDMM), a high-level gathering of defense authorities from countries in the South Pacific region. It is a multilateral working forum held annually with the participation of Australia, Chile, France, New Zealand, Papua New Guinea, Fiji, and Tonga. This meeting addresses a range of issues vital to regional security, such as defense cooperation, disaster management and response, the fight against transnational threats, and the promotion of stability and peace in a geopolitically strategic region. Participants share experiences and best practices in areas such as maritime security, emergency response, and the modernization of defense capabilities. In addition, initiatives are discussed to strengthen information exchange and coordinate joint efforts to address challenges affecting both traditional security and new threats.
- Another important aspect of this meeting is the promotion of strategic partnerships and regional integration, seeking a unified response to crisis situations and improving interoperability between the armed forces and security agencies of the various participating states. Likewise, collaboration with international organizations and allied countries is promoted, which contributes to enhancing the resources and capabilities available in the region. For this reason, Chile considers the SPDMM a key platform for dialogue and coordination among South Pacific nations, facilitating the development of common strategies that ensure the protection of their interests and stability in an area of growing geopolitical importance. It should be noted that in 2025, for the first time, Chile will host this meeting, which will take place in October in Valparaíso, reflecting the country's commitment to this

important event.

- Another relevant aspect is ocean governance, which refers to the set of rules, policies, agreements, and practices that regulate the use, conservation, and protection of marine resources and ocean ecosystems. Given that oceans are shared by multiple countries, governance requires a multilateral and coordinated approach to address global challenges such as maritime security and climate change. Chile must therefore actively participate in all international and regional forums that contribute to this purpose, promoting the recognition of ocean policy as a multilateral instrument that fosters an integrated and sustainable approach to the management of the seas, ensuring their long-term conservation and equitable and reasonable use by all nations (Álvarez, 2024, p. 27).

By actively participating in various international forums, Chile not only protects its interests but can also influence global norms, advocating for specific regional needs while fostering cooperation, which is essential for addressing the inherently transboundary nature of maritime climate challenges that no nation can effectively solve in isolation.

Conclusions and Recommendations

The preceding analysis demonstrates that climate change is not a hypothetical threat, but rather an evident reality that is redefining the contours of maritime security in the South Pacific, particularly for Chile, where the observed impacts generate cascading vulnerabilities. This affects port and coastal infrastructure, compromises navigation safety, and has severe repercussions on fishing, aquaculture, and food security.

Beyond the physical effects, there are profound socioeconomic implications, including the displacement of coastal communities and potential geopolitical tensions arising from competition for marine resources and possible changes in maritime boundaries, in a context of scarcity and humanitarian crisis.

Despite these growing challenges, Chile has demonstrated a proactive and multifaceted response, establishing a robust regulatory framework and mobilizing its naval and maritime institutions to integrate climate change into its strategic and operational planning. However, given the magnitude and complexity of the threat, continuous adaptation and enhanced multilateral commitments are required.

Evidence of potential climate tipping points underscores the urgency of proactive and anticipatory governance. Strategic investments in resilience and adaptation not only manage current risks but are essential to safeguarding maritime stability and future economic viability in the face of potentially abrupt and irreversible environmental transformations. It is imperative to act decisively now to avoid crossing thresholds that could lead to catastrophic and unmanageable consequences.

To strengthen the resilience and adaptation of maritime security in the South Pacific region, the following recommendations are proposed:

- **Data improvement and targeted research**
  It is essential to continue and expand regional climate modeling, associated with oceanographic monitoring that allows for the assessment of vulnerabilities, with an emphasis

on the most exposed locations. These data are important for adopting more precise and specific adaptation strategies, for a better understanding of the effects in the region.

- **Design and investment in adaptive infrastructure**
  Efforts should be made to systematically incorporate climate change projections into the design, construction, and improvement of all coastal and port infrastructure, prioritizing the use of adaptable materials and, where appropriate, integrating nature-based solutions to improve protection capabilities.

- **Integrated and dynamic management of the coastal zone**
  Accelerate the full implementation and continuous updating of policies such as Chile's National Coastal Zone Use Policy. This framework should ensure effective integrated management of coastal areas, effectively addressing complex land-sea interactions, mitigating environmental conflicts, and adapting to dynamic coastal changes.

- **Strengthening the resilience of maritime operations**
  Develop and regularly update robust protocols for port closures and navigation warnings, based on advanced forecasts of extreme weather events. Invest in cutting-edge technologies and specialized training for professionals in the field to effectively manage emerging risks.

- **Sustainable and adaptive management of fisheries and aquaculture**
  Implement and rigorously enforce adaptive management strategies for fisheries and aquaculture that explicitly take into account the displacement of fish stocks, the impacts of ocean acidification, and the increasing frequency of marine heatwaves.

- **Proactive regional cooperation and maritime diplomacy**
  Leverage Chile's established role and influence in international bodies (such as the IMO) and regional forums (such as the South Pacific Defense Ministers' Meeting) to promote greater regional and international cooperation on maritime security. This includes promoting joint scientific research, facilitating data sharing, coordinating emergency response mechanisms, and advocating for more ambitious reductions in global greenhouse gas emissions to mitigate long-term impacts.

- **Increase participation in naval and maritime exercises**
  Participation in international HADR exercises is essential to enhance collaboration between nations and agencies, allowing for the coordination of efforts and efficient allocation of resources in emergency situations. These practices can detect and correct flaws in protocols and chains of command, optimizing disaster response capabilities. Likewise, increasing the number of participating countries should be considered as a way to broaden commitment and awareness of this issue.

- **Public awareness and capacity building**
  Implement comprehensive public awareness campaigns and specific capacity-building programs for coastal communities, local authorities, and maritime professionals. These initiatives should focus on understanding the impacts of climate change on maritime safety, promoting adaptive behaviors, and improving local capacities for disaster risk reduction.

- **Establishment of a joint maritime surveillance and response mechanism to address climate threats**

It is suggested that SPDMM member countries promote the creation of a "South Pacific Maritime Information Fusion Center". This center could function as a permanent operational platform for coordinated surveillance and joint response to threats to maritime security resulting from climate change.

- **Stability of maritime borders in the face of climate change**
  Promote a regional agreement among SPDMM members and allied countries to create a technical-legal working group to develop a common regional position in the context of UNCLOS, reaffirming the stability of existing maritime borders, regardless of physical alterations to coastal baselines caused by climate change.

The effective implementation of these recommendations requires a holistic, interdisciplinary, and interagency approach by all stakeholders. This requires the seamless integration of scientific research, engineering, policy-making, socioeconomic considerations, and international diplomacy. No single sector, discipline, or government agency can adequately address all of these impacts in isolation; true resilience will come from synergistic collaboration, where maritime countries, particularly those in the South Pacific, have much to contribute.

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Induced displacement resulting from climate change: A pacific security imperative for the UN Security Council

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Abstract

Climate change has emerged as the most significant threat to international peace and security in the twenty-first century, with its impacts most acutely felt in vulnerable regions such as the Pacific. Rising sea levels, extreme weather events, and the erosion of habitable land are forcing communities to relocate, threatening state sovereignty and stability. This paper examines the evolving role of the United Nations Security Council (UNSC) in addressing climate security, focusing on induced displacement in Fiji, Tuvalu, and Kiribati. Drawing from regional frameworks—including the 2050 Strategy for the Blue Pacific Continent and Fiji's Ocean of Peace vision—it argues that climate-induced displacement should be recognized as a core security issue. The paper integrates the Women, Peace and Security (WPS) agenda to highlight the gendered dimensions of climate insecurity and proposes actionable recommendations for the UNSC to align its mandate with contemporary security realities.

Introduction

The United Nations Security Council (UNSC) carries the primary responsibility for maintaining international peace and security under the UN Charter. Traditionally, its agenda has been dominated by issues of armed conflict, interstate disputes, terrorism, and nuclear proliferation. However, climate change has emerged as the most profound and far-reaching threat to humanity, with cascading impacts that extend beyond the environmental sphere into political, economic, and human security domains (UNSC, 2022).

Small Island Developing States (SIDS) in the Pacific—particularly Fiji, Tuvalu, and Kiribati—are at the frontline of this crisis. Rising sea levels, extreme weather events, salinization, and land loss are forcing communities to relocate, eroding sovereignty and cultural identity. This phenomenon, referred to as climate-induced displacement, has direct implications for international peace and security. As entire populations are displaced, the potential for statelessness, contested maritime boundaries, resource competition, and geopolitical instability increases.

While the UNSC has intermittently discussed climate-security links since 2007, its response has been limited, fragmented, and politically contested (UNSC, 2022). Integrating the Women, Peace and Security (WPS) agenda further reveals how climate change exacerbates gendered vulnerabilities while also highlighting the role of women as agents of resilience and peacebuilding. This paper situates Pacific displacement within the broader global climate-security discourse and argues that the UNSC must act decisively to address climate change as a core security issue.

Climate Change and Security: The Evolving Role of the UN Security Council

The UNSC first formally debated climate change as a security issue in 2007 under the UK presidency. While many member states acknowledged the potential security implications of climate change, others questioned whether it fell within the Council's remit. Subsequent debates in 2011 resulted in a Presidential Statement acknowledging that climate change may aggravate existing threats to international peace and security (UNSC, 2022).

Efforts to adopt a thematic resolution on climate and security reached a critical point in December 2021, when Niger and Ireland tabled a draft resolution that would have formally recognized climate change as a security threat and requested the Secretary-General to integrate climate-related security risk assessments into the work of UN missions. The resolution received broad support but was vetoed by Russia, with India and China also expressing reservations about the Council's role (UNSC, 2022). This event highlighted deep political divisions over whether the UNSC should institutionalize climate security.

Despite this setback, climate considerations have increasingly been mainstreamed into peace operations. For example, in 2022 the UNSC renewed the mandate of the United Nations Mission in South Sudan (UNMISS) through Resolution 2625, which required the mission to incorporate gender-sensitive climate security risk assessments—a landmark integration of the WPS and climate agendas (UNSC, 2022). Arria-formula meetings have also expanded, focusing on issues such as climate finance, peacebuilding, and early warning systems.

However, the Council's approach remains largely reactive rather than preventive. It has yet to adopt a binding resolution that addresses the existential challenges posed by climate-induced displacement, particularly for low-lying states facing territorial loss and population movement.

Climate-Induced Displacement in the Pacific

The Pacific region is widely recognized as ground zero for climate-induced displacement. The State of the Climate in the South-West Pacific 2024 report confirmed that 2024 was the hottest year on record in the region, with severe marine heatwaves, intensified cyclones, and accelerated sea-level rise (WMO, 2025). Global mean sea level is rising at rates unprecedented in the last 3,000 years, with projections indicating significant submersion of low-lying atolls within decades (NASA SLCT, 2024; IPCC, 2021).

For Pacific SIDS, this crisis is multidimensional. It threatens food and water security through salinization of freshwater aquifers and destruction of crops; undermines economic security by damaging fisheries and tourism; erodes state sovereignty through potential loss of territory; and poses human security risks through forced displacement. Unlike sudden-onset disasters, sea-level rise is a slow-onset process that progressively renders land uninhabitable, complicating traditional displacement frameworks under international law.

The 2050 Strategy for the Blue Pacific Continent frames climate change as the single greatest existential threat to the region, emphasizing sovereignty, security, and human rights dimensions (PIFS, 2022). The Strategy calls for coordinated regional action and global recognition of

displacement as a security issue, aligning with Fiji's Ocean of Peace vision, which frames climate change as both a threat and a catalyst for regional solidarity (Prime Minister of Fiji, 2025).

Case Studies: Fiji, Tuvalu, Kiribati

Fiji

Fiji has emerged as a regional leader in responding to climate-induced displacement through legislative innovation, planned relocation, and integration of climate resilience into defense strategy. The relocation of Vunidogoloa village in Vanua Levu in 2014 marked the world's first state-managed climate relocation. Since then, over 40 communities have been identified for relocation under the Climate Change Act 2021, which institutionalizes planned relocation through a rights-based framework (Government of Fiji, 2021).

The Republic of Fiji Military Forces (RFMF) play a dual role, focusing on both defense and humanitarian assistance and disaster relief (HADR), as outlined in the RFMF Capability Plan 2024–2030 (RFMF, 2024). This approach positions Fiji as both a frontline state and a regional enabler, offering practical models for adaptation and security integration.

Tuvalu

Tuvalu faces an existential threat, with an average elevation of just two meters above sea level. It has pioneered legal innovations such as recognizing permanent maritime zones irrespective of land loss, to preserve sovereignty even if the territory becomes submerged (PIFS, 2022).

Historically, Fiji has served as a safety net for Tuvalu. In the 1970s, it allocated Kioa Island for Tuvaluan settlers as part of an anticipatory adaptation strategy. In 2006, the Fijian Parliament passed legislation allowing descendants of these settlers to be naturalized as Fijian citizens, formalizing a legal pathway for potential climate migrants.

Tuvalu's situation raises profound legal and security questions. What happens to statehood, citizenship, and international legal personality when territory disappears but populations remain? These questions underscore why the UNSC must engage with displacement not merely as a humanitarian issue but as a fundamental security concern.

Kiribati

Kiribati is grappling with salinization of aquifers, loss of arable land, and intensifying king tides that threaten to make its islands uninhabitable. Its "migration with dignity" policy includes purchasing land in Fiji for future relocation—a proactive but politically complex measure.

Like Tuvalu, Kiribati has historical links to Fiji. In the 1970s, Rabi Island was allocated to I-Kiribati settlers. The 2006 parliamentary legislation similarly allowed their descendants to acquire Fijian citizenship, creating a legal bridge for future relocation.

However, relocation risks cultural erosion, identity loss, and statelessness, particularly for populations whose identity is tied to ancestral land and marine stewardship. The displacement of entire nations like Kiribati would challenge existing legal frameworks and strain regional security architectures.

Integrating the Women, Peace & Security Agenda

Climate change and induced displacement are not gender-neutral phenomena. The Women, Peace and Security (WPS) agenda—first articulated in UNSC Resolution 1325 (2000)—emphasizes the importance of women's participation, protection, and leadership in conflict prevention, peacebuilding, and security governance. Integrating a gender lens into climate-security frameworks is essential to understanding how climate impacts are experienced unevenly and how women's leadership contributes to resilience.

Climate change exacerbates gendered insecurities in multiple ways. Women and girls are disproportionately affected by water scarcity, food insecurity, and health burdens arising from climate impacts (UNSC, 2022). In many Pacific communities, women bear the responsibility for securing water, food, and caregiving, which becomes increasingly difficult as resources degrade due to sea-level rise and salinization. During displacement or relocation, women face heightened risks of gender-based violence, exploitation, and loss of traditional support networks.

At the same time, women are key agents of adaptation and peacebuilding. Pacific women lead community-based adaptation initiatives, manage traditional resource systems, and play vital roles in conflict mediation within customary governance structures. The integration of gender-sensitive risk assessments in UNMISS's mandate through Resolution 2625 (2022) demonstrates how WPS principles can shape international responses to climate-security risks (UNSC, 2022). This precedent should be extended to Pacific contexts where climate-induced displacement intersects with geopolitical competition, sovereignty concerns, and humanitarian needs.

A gender lens also enriches security analysis. For example, forced migration and relocation often restructure community power dynamics, sometimes sidelining women's voices in decision-making about land, resettlement planning, and resource governance. Ensuring women's meaningful participation at all stages—from policy formulation to relocation site design—aligns with both WPS principles and effective adaptation strategies.

Policy and Security Implications

The Pacific experience illustrates that climate-induced displacement is not only a humanitarian challenge but a security issue with legal, geopolitical, and social dimensions. The potential disappearance of entire states like Tuvalu and Kiribati raises unprecedented questions for international law regarding sovereignty, maritime boundaries, and the legal status of displaced populations. Without proactive international frameworks, these situations could lead to contested jurisdictions, statelessness, and diplomatic tensions.

For the UNSC, this represents a critical mandate intersection between Article 24 of the UN Charter and contemporary security realities. Climate change acts as a threat multiplier, exacerbating

existing vulnerabilities and creating new fault lines that can destabilize regions (IPCC, 2021; UNSC, 2022). The Pacific's strategic position within the Indo-Pacific further heightens the stakes, as external powers seek influence amidst climate-driven vulnerabilities (PIFS, 2022).

The Council has already begun integrating climate language into some peace operation mandates, but its current approach is fragmented, reactive, and often gender-blind. There is no dedicated mechanism for addressing slow-onset displacement, nor an institutionalized process for incorporating regional frameworks such as the 2050 Strategy for the Blue Pacific Continent into its deliberations.

Climate finance remains a major bottleneck. Fragile and conflict-affected states receive only $2.10 per person annually in climate finance compared to $162 in non-fragile states, despite bearing the brunt of climate risks (UNSC, 2022). Pacific SIDS face similar disparities, impeding their ability to implement relocation and adaptation strategies at scale. Moreover, gender-responsive financing remains limited, despite the evidence that empowering women leads to more sustainable adaptation outcomes.

The policy gap is therefore twofold: (1) the UNSC has not recognized climate-induced displacement as a security issue requiring formal action; and (2) global financing and legal frameworks are insufficient to address the scale and gendered nature of the crisis.

Recommendations

In light of the growing urgency of climate-induced displacement in the Pacific, particularly for Fiji, Tuvalu, and Kiribati, the following recommendations are proposed to guide the United Nations Security Council and the international community. They aim to elevate climate change from an environmental concern to a central security priority, ensuring that affected populations are afforded protection, dignity, and long-term resilience. These actions build on Pacific-led frameworks such as the 2050 Strategy for the Blue Pacific Continent and Fiji's Climate Change Act 2021, and are designed to align global security governance with the lived realities of vulnerable states.

a. **Adopt a Thematic UNSC Resolution on Climate and Securi**ty

The UNSC should adopt a binding resolution that recognizes climate change—including slow-onset impacts—as a threat to international peace and security. This resolution should integrate displacement considerations and explicitly reference gendered impacts in line with the WPS agenda.

b. Institutionalize Climate-Security Risk Assessments

All relevant UN missions and regional presences should conduct gender-sensitive climate-security risk assessments, similar to those mandated for UNMISS (UNSC Resolution 2625). This would strengthen early warning and prevention capacities in climate-vulnerable regions.

c. Appoint a UN Special Representative on Climate and Security

Establishing a high-level position would centralize climate-security issues, improve coordination across UN agencies, and ensure that Pacific displacement concerns receive sustained attention.

d. Enhance Legal Frameworks for Climate-Displaced Populations

The UNSC should support the development of international legal mechanisms that address sovereignty, maritime boundaries, and the status of climate-displaced persons. Particular attention should be given to Pacific nations facing the loss of habitable territory.

e. Scale Up and Gender-Target Climate Finance

The Council should work with international financial institutions to mobilize climate finance for adaptation, relocation, and peacebuilding. Financing should include gender-responsive mechanisms to empower women's leadership in climate resilience.

f. Support Regional Frameworks and Pacific Leadership

The UNSC should engage with Pacific-led frameworks such as the 2050 Strategy and Fiji's Ocean of Peace initiative. These provide culturally grounded, regionally owned models for addressing climate-security challenges that can inform global governance.

Conclusion

Climate-induced displacement in the Pacific is not a future scenario—it is already happening. Fiji's planned relocations, Tuvalu's legal innovations, and Kiribati's migration strategies exemplify both the scale of the threat and the ingenuity of local responses. Yet these efforts operate within a global governance system that has not fully recognized climate change as a security issue.

The UNSC stands at a strategic crossroads. Its current reactive posture is inadequate for addressing slow-onset displacement that undermines sovereignty, destabilizes regions, and threatens international peace. By adopting a proactive approach—grounded in regional frameworks, legal innovation, and the Women, Peace and Security agenda—the Council can align its mandate with twenty-first century realities.

For Pacific states, this is not merely a question of survival, but of survival with dignity, sovereignty, and agency. Recognizing climate-induced displacement as a core security challenge is both a moral imperative and a strategic necessity for the maintenance of international peace.

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Assessment of the vulnerability of sites to climate change in New Caledonia and French Polynesia

Julie Bonneau Dorin, France.

Introduction

Characterised by its "extreme oceanicity"[1], the South Pacific region is one of the most affected by climate change effects. It is therefore particularly vulnerable to the many climate hazards such as cyclones, tsunamis, droughts, or torrential rains. These types of climate-related natural disasters are set to intensify in both frequency and severity[2].

One of the main threats to the archipelagic territories of the South Pacific is rising ocean levels. Depicted as an "existential threat"[3] by the population, this threat could eventually lead to partial, or even total, disappearance of the territories, while calling into question their sovereignty, their rights, and their citizenship.

This paper will primarily focus on the French overseas territories of French Polynesia and New Caledonia, and proposes some recommendations.

Assessment of climate status and trends in the French overseas territories in the Pacific

New Caledonia

Assessment of climate status and trends in New Caledonia

Due to its subtropical location, New Caledonia is subject to seasonal variances, both tropical and temperate. The hot humid season extends from November to April, with a peak from January to March. The tropical influence predominates, with high temperatures that are limited in intensity by the effect of trade winds (generally between 25° C and 30 °C). The rainy season marked by abundant and frequent rainfall, often in the form of heavy thunderstorm showers. This period also corresponds to the season, when tropical cyclones can form, bringing strong winds and torrential rain with various pathways.

Climate change leads to a global decrease in annual precipitation volumes, while amplifying the number of intense rain days, as well as the duration and intensity of dry periods. It therefore increases risks of floods and wildfires/forest fires.

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[3] https://www.icj-cij.org/sites/default/files/case-related/187/187-20250723-adv-01-00-en.pdf

The duration of the hot season, which currently is from November to April, is progressively increasing to 8 to 9 months, extending from September or October to May. The number of hot days (when temperature is above 25°C according to METEO FRANCE) has already doubled in 60 years in some parts of the north of the archipelago. Heatwaves are longer and more intense. The quantity of the most intense cyclonic events will also increase due to the disruption of the climate system. The maximum intensity may increase, whether in the speed of the fastest winds (El Nino phase) or in precipitation volumes (La Nina phase)[4].

Source: Encyclopeadia Universalis

Main climate risks by 2050-2100 for military sites and bases

According to the most pessimistic scenario of the Intergovernmental Panel on Climate Change (IPCC) (SSP5-8.5), New Caledonia will be particularly affected by climate change effects (hurricanes, droughts and torrential rain). Heatwaves, both terrestrial and marine, will be multiplied by 50 percent between today and 2050, causing a disruption of the entire climate system of the archipelago. As a result, a 20 % decrease in overall precipitation is to be expected between 2080 and 2100, however, extreme precipitation events will increase by 5 to 7 % for each additional

[4] El Niño and La Niña, both of which significantly alter global weather patterns. El Niño can be identified by a number of different measures, including higher-than-usual sea surface temperatures in the eastern tropical Pacific. During La Niña periods, the normal east-to-west winds become stronger, pushing warm waters further west.This causes cold water to rise – or "upwell" – from the depths of the ocean, making sea surface temperatures cooler than usual in the eastern Pacific.

degree. The hurricane season will be more unpredictable and violent due to "marine heatwaves" that will foster the formation of hurricanes[5].

Sea levels have already risen by 6 cm in the last 60 years, confronting the Caledonian territory with significant issues of coastal erosion where 71 % of the shoreline is exposed to this phenomenon[6]. Noumea has experienced a very high level of coastal artificialisation in recent decades, with many areas reclaimed from the sea. Costal artificialisation is defined as the transformation of land use to urban developments such as housing, industrial use or public facilities (Garcin and Vende-Leclerc, 2020). The filled-in areas are highly exposed to submersion. Erosion, heavy swells and submersion are hazards, and these effects reinforce each other. Threats of submersion also apply to the island of Ouvea, raising the complex issue of the eventual relocation of its inhabitants. These threats pose risks for the armed forces bases and training capabilities.

Major climate risk prevention and management policy is weak. Only a few municipalities have established risk prevention documents. Essentially municipal, civil security, fire and rescue assets often resort to assets of the armed forces. This poses a risk as it strains the capabilities of the armed forces by diverting people and resources.

French Polynesia

Climate status and trends in French Polynesia

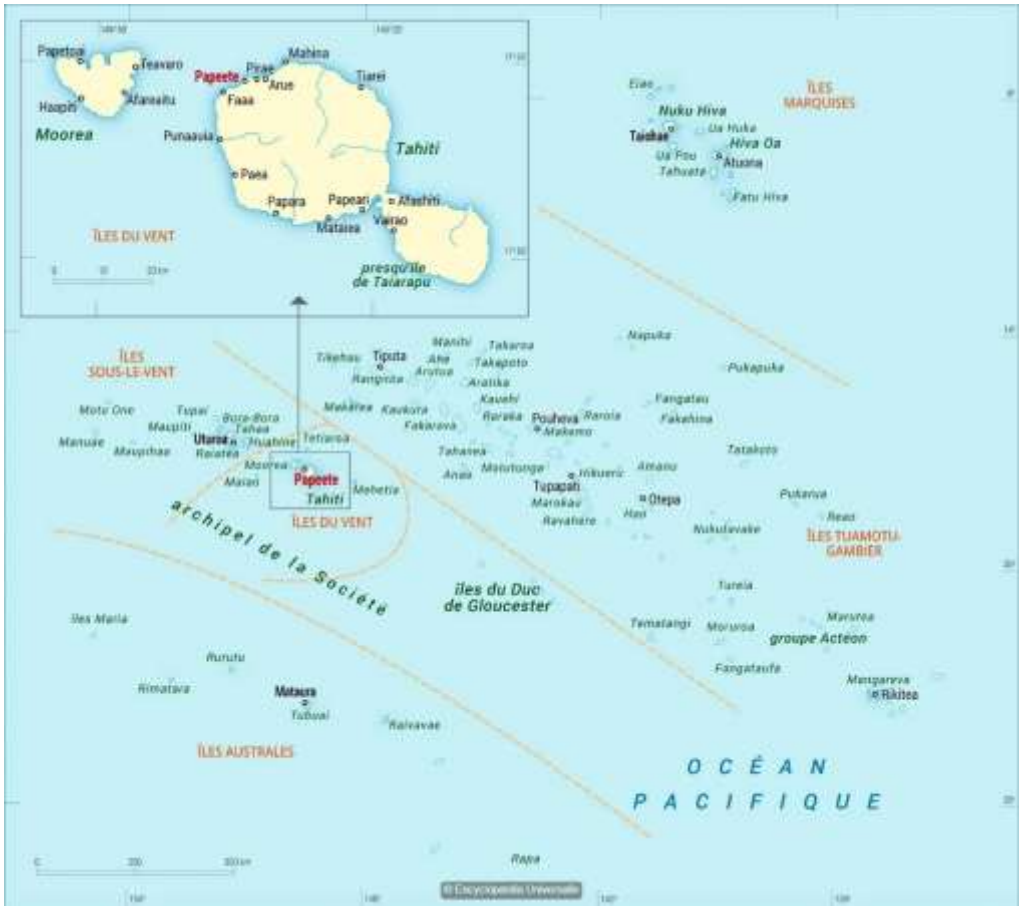
The climate in French Polynesia is mostly humid tropical, though certain islands in the northern part of the archipelago tend towards an arid tropical climate. The entire archipelago is subject to the influence of climatic phenomena such as El Nino and La Nina, which can disrupt usual meteorological conditions and indicators[7]. French Polynesia is not spared from extreme weather phenomena (flooding, cyclones, and forest fires) and the consequences of climate change (drought, sea level rise, ocean acidification and torrential rain). Cyclones are considered the main natural factor of destabilisation of the archipelago.

[5] Choi, HY., Park, MS., Kim, HS. *et al.* Marine heatwave events strengthen the intensity of tropical cyclones. *Commun Earth Environ* **5**, 69 (2024). https://doi.org/10.1038/s43247-024-01239-4

[6] Analyse de la résilience des installations militaires françaises au changement climatique, Forces armées en Nouvelle Calédonie - Alexandre Thaite et Elisande Nexon - 10/2024 - FRS

[7] *Ibid*

The increase in temperatures in French Polynesia, and more broadly in the Pacific islands, is in line with the global rise, with a tempering effect provided by the ocean, which warms up more slowly than the land. However, temperatures in the South Pacific exceed the global average by 0.5° C[8].



Source: Encyclopaedia Universalis

Main climate risks by 2050 for military sites and bases

Flooding caused by increased intense precipitation, urban floods and/or storm surge is the most pressing risk for military sites in the north and northwest of Tahiti, and for the basin of these sites[9]. Economic activities, the circulation of goods and people, networked services, and the airport are likely to be interrupted for several days when flooding occurs. The flood risk has become structural in the inhabited areas of the high islands, with few solutions on the sites to prevent this. Several risks leading to storm surge threaten the coastlines with erosion and submersion: sea level rise, distant swell (born from distant tropical depressions), cyclonic swell, seasonal swell, with an

[8] State of Climate in the South-West Pacific, 2024, World Meteorological Organization.

[9] Analyse de la résilience des installations militaires françaises au changement climatique, Forces armées en Nouvelle Calédonie - Alexandre Thaite et Elisande Nexon - 10/2024 - FRS

increase in the average height of waves[10]. These factors also contribute to the flood risk, which coastal and nearby bases are exposed to.

Submersion and a combination of associated hazards, are the second most significant risk for infrastructure in the north and northwest of Tahiti. The probable degradation of coral reefs by 2030 makes the hypothesis of the disappearance of many atolls (including Moruroa, Fangataufa) more plausible[11]. Although it is almost unthought-of in Polynesia, it is already projected for other Pacific islands. The tropical cyclone is a threat too often perceived as disseminated, in frequency and distance, despite the considerable damage it can cause on the scale of the atolls affected, notably in Tuamotu-Gambier.

The passage of a tropical cyclone over the densely populated areas of the high islands would have catastrophic consequences, particularly in Tahiti, far exceeding the civil and military state crisis management capacities (e.g. water and housing for disaster victims, medical support, etc.). The unavailability of the airport, even limited to a few days, would make it very difficult for aid to arrive from metropolitan France.

How resilient should systems be?

The vulnerabilities of the armed forces to climate change in the Indo-Pacific are also those of the civil society and institutions. These vulnerabilities are systemic issues that are specific to the French overseas territories. All the more so for the armed forces as the rise in temperatures, coupled with humidity, already increasingly constrains the training of forces, administrative tasks, maintenance operations in technical areas, and more broadly daily life. The increasing impacts of climate change will further exacerbate these stressors. The integration of overseas territories into the wider region represents a major challenge due to their dependence on metropolitan France. Disruptions due to extreme weather events has knock-on social, health and security consequences, since the geographical distance represents a very great logistical challenge for the arrival of aid by air bridges[12].

Resilience can, be gained through the process of learning from past disasters. Thus, recent climatic events such as the massive flooding of northern Tahiti in 2017 are perceived as the consequence of negligence (in this case, in the maintenance of river courses) than as the long-term evolution of climatic characteristics, amplified by maladaptation[13].

How should the French Armed Forces react to better adapt?

On an operational level, the armed forces of the region are at the forefront of the fight against climate change. Not only as responders through emergency rescue operations and evacuations, but also as those impacted through tensions on military resources and resilience of infrastructure. The

[10] *Ibid*

[11] *Ibid*

[12] Ivan Sand, Nessim Ababou, Sébastien Borrego, « Crise en Nouvelle-Calédonie : un pont aérien inédit pour l'Armée de l'air et de l'Espace » Revue n° 874 Novembre 2024 - p. 32-38

[13] Analyse de la résilience des installations militaires françaises au changement climatique, Forces armées en Nouvelle Calédonie - Alexandre Thaite et Elisande Nexon - 10/2024 - FRS

French Armed Forces work daily on the resilience of their bases and to ensure the proper maintenance in operational condition within a challenging environment (insularity, salinity, premature ageing of equipment). In this regard, rising temperatures will increasingly constrain the training of the French Armed Forces in French Polynesia and New Caledonia. For instance, an additional degree of air temperature from 30° C to 31 °C (still at 80 % humidity) leads to a perceived temperature of 41 °C.

The maintenance in operational conditions and durability of equipment are key to improving the resilience of the armed forces in the face of climate change. Due to their remote and exposed nature, the French overseas territories in the South Pacific offer both difficult training conditions and premature ageing of equipment due to ambient humidity and salt spray.

In this regard, the Climate and Defence Strategy of the French Ministry for the Armed Forces, published in April 2022, addresses the challenges of climate change by focusing on a key tryptic: understand, anticipate, adapt. This unclassified strategy is translated into English and can be distributed to all partners[14]. This approach to sharing is in line with the commitments made during SPDMM (2023) by the countries of the South Pacific, namely the sharing and pooling of "best practices". It is in accordance with this strategy that the Ministry for the Armed Forces has set up a climate vulnerability audit system for its bases in the overseas territories. The audit is based on several criteria (see table below), thus allowing the assessment of the need and, ultimately, proposing avenues for improving the climate resilience of the bases.

	Effect on the functions, infrastructure or terrain of the bases			
	Catastrophic: - permanent loss of function - and/or of a part or the totality of a site	Major: - Regular loss of a function - and/or regular unavailability or inaccessibility of part, or occasional un	Significant: - occasional loss of a function - and/or occasional unviability of a part of the site	Minor: Functions ensured or supported by the site
Very probable				
Quite probable				
Probable				

Table from the report: vulnerability audit of French military bases (*Analyse de la résilience des installations militaires françaises au changement climatique Alexandre Taithe - Elisande Nexon - 2023 – FRS)*

Due to the strong interdependence and interconnection of Pacific countries, the vulnerability of infrastructure must be considered at the regional level and not just at the national or local level. In fact, damaged infrastructure, such as airports, in one part of the region can threaten the provision of vital and basic services in other parts of the Pacific region, particularly in the most remote areas. Military infrastructure is generally dealt with separately from civilian infrastructure in

[14] Presentation Climate ans defence strategy.pdf

vulnerability assessments. However, military bases usually suffer from the same vulnerabilities as civil infrastructure. The sensitive, secure nature of military infrastructure can be appropriately managed, while sharing best practices on how to mitigate the effects of climate change. There is a risk that climate impacts may prevent the armed forces from fulfilling their own environmental protection obligations.

Recommendations and avenues for cooperation

This paper proposes some recommendations:

- Enhancing scientific knowledge by capitalising on local expertise and feedback.
- Strengthening civil society and military personnel awareness and training, in particular with the support of the Pacific Academy.
- Taking into account the importance of building infrastructure that withstands abovementioned climate impacts in order to ensure our ability to quickly restore destroyed infrastructure after a disaster.

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Climate Change in the Pacific – Short analysis of risks and issues.

Cameron Diver, France

This short note, which does not intend to be exhaustive, aims to rapidly highlight some key risks and issues relating to the impacts of climate change in the Pacific region. It assumes acceptance of the scientific findings of reputable international expert bodies, such as the Intergovernmental Panel on Climate Change, on the existence of ongoing negative impacts of a changing climate on the environment, human security and wellbeing.

Context

The 2023 World Meteorological Organization State of the Climate in the South-West Pacific report indicates that sea-level rise in the region (10-15cm in the Western tropical Pacific and 5-10cm in the Central tropical Pacific since 1993) is double the global average and sea-surface temperatures have risen three times faster than the global average since 1980. The average elevation of Pacific islands is 1 to 2 metres above sea level, 90% of the population lives within 5km of the coast and half of all infrastructure is within 500 metres of the sea (WMO, 2024). This has generated more frequent coastal flooding, dramatic increases in marine heatwaves, ocean acidification and coral bleaching. NASA analysis confirms that, over the next 30 years, islands such as Tuvalu, Kiribati and Fiji will experience at least 15cm of sea-level rise with the number of high-tide flooding days in an average year increasing by an order of magnitude for nearly all Pacific Island nations by the 2050s (NASA, 2024).

These trends will likely render many islands uninhabitable due to increased environmental stressors such as high salinity soils, inability to cultivate crops, extreme weather events, and contaminated fresh water before the end of the century. It is predicted, for example, that most atoll islands will have no potable water by 2060 (Storlazzi *et al*, 2018).

As such, according to the UN's high level panel on internal displacement, every year more than 50,000 people in the Pacific are forced to flee their homes because of the devastating impacts of disasters and climate change. In addition, the 2015 UN Institute for Environment and Human Security modelling, assuming a medium climate change scenario (RCP 6), estimates that by 2055 international migration trips for atoll nations Kiribati and Tuvalu will increase by 35% and 100%, respectively. However, the same study, which draws from the Pacific Climate Change and Migration project, notes that most potential Pacific climate migrants will not have the financial means to migrate. Finally, for an overall trend, Ash & Campbell (2016) indicate that the total number of climate migrants in the Pacific region will be between 0.6 million to 1.8 million by 2050.

Consequences

The changing environment is likely to drive both internal and external population displacement, create tension around legal regimes such as baselines for the measurement of maritime boundaries and, in extreme cases where entire islands are depopulated, pose the

question of statehood (eg. a climate-failed State that no longer exists under the traditional legal criteria because it no longer has a permanent population or has a significant reduction in its defined territory because of climate change and sea-level rise). Issues may also arise around national governments in climate-enforced exile (take the hypothetical example of Kiribati shifting its populationto Fiji, as was foreshadowed at the time by former President Anote Tong). How do these governments maintain sovereignty to manage the affairs of a State where they are no longer physically present and can they, as such, enter into and maintain relations with other states? This in turn raises other questions around the ongoing citizenship of climate migrants in their State of origin, should the latter cease to legally exist with a slew of consequences that require anticipation and, most probably, a change to existing legal regimes to be addressed appropriately.

Notwithstanding the Pacific Island Forums' Declarations on Maritime Boundaries and Statehood, which are political in nature and only signal normative intent without legal force, in the current multilateral context, take into account the significant economic value of the natural resources found currently within Pacific island Exclusive Economic Zones (EEZ) such as tuna and deep sea minerals. Pacific islands face a significant risk their maritime boundaries, sovereignty and statehood will be challenged by certain international actors before the end of the century driven by the impact of climate change and sea-level rise combined with geopolitical competition.

Recommendations

This note does not aim to reproduce the many recommendations made elsewhere. It would suggest, however, that there is an intrinsic and often overlooked link between sustainable development (notably addressing the multisectoral impacts of climate change) and security and defence. In highly vulnerable contexts such as islands or coastal zones, environmental stability (or the lack thereof) is a critical aspect of political and social stability/instability. It is, therefore, a factor to be considered when assessing the risks of rising domestic or international tensions due to, for example, changes in the natural environment or access to natural resources. As such, it is suggested that countries should:

a) Anticipate an increase in competition for livelihood sustaining resources (ie. fresh water, cultivatable land, fish stocks and shelter) and therefore the increased likelihood of internal and, potentially, external conflict for such resources as populations are displaced domestically and then internationally due to the effects of climate change.

b) Anticipate potential cultural conflicts as populations move between islands, sub-regions and more broadly, particularly when displaced groups from Pacific islands settle in areas and may not share the strong local or indigenous culture rooted in a sense of place of existing populations.

c) Develop strategies and actions to mitigate the weaponisation of climate migration and access to or sovereignty over (including sovereign rights in the EEZ) livelihood sustaining and economic resources, particularly in the perspective of increased geopolitical competition in the Pacific region.

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The 'Mission Bougainville': A Planetary and Continuous Measurement of the Ocean Microbiome by Young 'Biodiversity Officers' Embarked Aboard French Navy Vessels

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Context and vision

The ocean microbiome at the heart of planetary ecology. Seawater is teaming with life. There are between 10 and 100 billion organisms—viruses, bacteria, protists, and animals—in every litre of seawater across the planet. The number of species is still unknown but certainly exceeds tens of millions. This life, mostly invisible to the naked eye (<1mm), is known as *plankton* or the *ocean microbiome*. Today, we know that these invisible forests drifting with ocean currents for four billion years have played a major role in making Earth habitable, long before animals and plants appeared. Most of the oxygen in our atmosphere and many of the genes that make up our genome

come from ocean life (Falkowski 2012). The ocean microbiome continues to perform key planetary functions (such as the carbon pump) and regulates the overall health of the oceans. It underpins the productivity of macroscopic marine life—mollusks, crustaceans, fish, birds, and mammals—and harbors millions of still unknown genes and molecules with potential value for human health and the global economy (Grigoratou et al. 2025). Exploring and understanding the biodiversity, functions, dynamics, and ecological and evolutionary mechanisms of the ocean microbiome is one of the most exciting scientific adventures of our century—but also an urgent one. We must indeed understand how this vast living majority can resist and adapt to the local and global impacts of the Anthropocene, and how changes in marine microbiomes will affect the ecology and economy of the ocean.

Unlocking planetary biology with 'Plankton Planet' and the mission Bougainville. To truly understand plankton, we must measure it in all its complexity, and especially its planetary-scale dynamics. Like all microbiomes, plankton knows no borders. It drifts with ocean currents and can even be transported through aerosols, crossing entire ocean basins in just weeks or months. Functionally, plankton can be considered a vast planetary body, making it largely meaningless to study it in a single area. From 2009 to 2013, we organized the first holistic study of global plankton by systematically deploying a suite of protocols to capture genetic and morphological data on the ocean microbiome during a round-the-world expedition aboard the schooner *Tara* (Sunagawa et al. 2020). This project, *Tara Oceans*, led to the discovery of hundreds of thousands of plankton species and hundreds of millions of genes—most of them previously unknown. It established a new data baseline for oceanic plankton, which has since been used in hundreds of research papers on plankton biodiversity, ecology, and evolution published by the international scientific community (e.g. de Vargas et al. 2015; Carradec et al. 2018; Dominguez-Huerta et al. 2022; Paoli et al. 2022).

However, the *Tara Oceans* mission represents a snapshot of the ocean ecosystem, measured at around 200 sites and three depths. To truly understand the live ocean, it must be measured across its full spatio-temporal dynamic —just as satellite observations or the Argo float network (Kavanaugh et al. 2021; Roemmich et al. 2019) do for ocean (bio)physical parameters. But this presents a huge challenge when it comes to biodiversity/biocomplexity data, and we are still facing a vast desert of globally consistent biological information in ocean science. Thus, in 2016 we launched the *Plankton Planet* (P2) initiative, which aims at establishing, by 2030, the first *seatizen*-based standard measure of the surface ocean microbiome across planetary scales. The P2 strategy rests on three pillars: (*i*) developing affordable and user-friendly instruments and protocols for consistent field sampling and cutting-edge measurement of aquatic microbial life and related environmental parameters; (*ii*) training 'seatizens' (any sea farers, explorers, or users, e.g. aquaculturists, fishers, managers, researchers, and crews of all types of vessels) to the use of these tools, enabling their widespread and consistent deployment from various platforms such as sailing or fishing boats, cargo ships, or marine research stations; (*iii*) sharing standardized aquatic biodiversity data and indexes collected locally, in global databases making them accessible for exploration by all stakeholders. We believe that the P2 bottom-up, collective, cost-effective and distributed strategy has the capacity to overcome the main scientific, technological, financial, societal and regulatory barriers hampering planetary ocean biology (Bertucci et al. in review), and

thus provide a solution that will contribute to the transformation of our understanding and forecasting of ocean function, evolution, and health.

After an initial global survey of plankton biodiversity based on environmental DNA, carried out by a fleet of 20 citizen sailing boats—with data quality equivalent to that obtained during the *Tara* Oceans expedition (de Vargas et al. 2022) —P2 developed a kit of low-cost instruments and simple protocols to systematically measure the planktonic ecosystem (e.g., Pollina et al. 2022; Mériguet et al. 2022). In 2022, the P2 consortium partnered with the Sorbonne University's Institut de l'Océan and the French Navy to launch "Mission Bougainville." The idea behind Mission Bougainville is to bring together existing academic, governmental, and citizen forces to explore and measure the oceanic microbiome on a planetary scale. This ocean exploration is led by recent graduate students who have just completed French 1 or 2 Masters Degrees, to serve as "*Biodiversity Officers*" (BiO) during a gap-year aboard a French Navy vessel, inspired by the spirit of the first French circumnavigation led by Louis-Antoine de Bougainville on *La Boudeuse*. The BiOs are trained in the use of the cost-effective tools and protocols developed by P2, and they apply them at sea together with the professional navy sailors, whenever possible depending on military operations. Mission Bougainville enables sampling of the surface ocean microbiome at unprecedented spatio-temporal scales, while also opening the eyes of patrol ship crews to the extraordinary beauty and diversity of invisible life that inhabits every liter of seawater, forever transforming their perception and understanding of the environment they have chosen to protect.

In this article, we report on the pilot phase of Mission Bougainville (2023–2025), present initial results, and discuss the upcoming operational phase (2025–2030), as well as its potential for expansion to other Navies, particularly those involved in the South Pacific Defense Network (Australia, Chile, Fidji, France, New Zealand, Papua New Guinea, Tonga).

The Pilot Project of the Mission Bougainville (2023–2025)

Mission Bougainville was officially launched in September 2023, initiating a first operational test phase over a two-year period. The objectives of the pilot project were as follows:

- Finalize the development of a cost-effective and easy-to-use instrumentation kit for the measurement of aquatic microbiomes.
- Establish the process for selecting, recruiting, and training post-Master's students from Sorbonne University in both scientific and military tasks, to enable their recruitment into the French Navy as *Biodiversity Officers* (BiOs).
- Conduct a consistent two-year measurement campaign of ocean micro-biodiversity and planktonic ecosystems across the Indo-Pacific basin (Reunion Island, New Caledonia, Tahiti).
- Develop a long-term protocol deployment plan aboard navy vessels and beyond.

The first step was therefore to finalize a set of low-cost and field-handy instruments designed to measure both the genetic and morphological biodiversity of plankton, as well as key environmental

parameters of the sampled water column (Figure 1). The kit includes six instruments (four of which were developed by the P2 consortium) designed to: (*i*) collect different fractions of the ocean microbiome; (*ii*) process plankton samples for quantitative onboard imaging and DNA metabarcoding analysis in the laboratory; (*iii*) measure basic contextual oceanographic parameters such as temperature, salinity, and light.

Figure 1. The innovative 'P2-Bougainville' kit for frugal oceanography. 1. 20-µm and 50-µm nets: plankton nets with specific mesh sizes deployed at each sampling station, either vertically or horizontally. **2. CTD probe**: a commercial probe equipped with sensors measuring conductivity (salinity), temperature, and depth during each deployment at a sampling station. **3. *Lamprey***: a portable mini-station for filtering planktonic biomass, equipped with a 47 mm diameter membrane filtration funnel connected to a peristaltic pump. **4. *PlanktoScope***: a portable, semi-continuous flow microscope designed for quantitative imaging (counting, measuring, classification) of planktonic organisms and particles between 50 and 200 µm. **5. *Curiosity microscope***: a compact and user-friendly digital microscope with four magnifications (x2, x5, x10, x20), allowing semi-quantitative observation and imaging of plankton (organisms between 10 and 2000 µm). **6. PAR sensor**: sensor for continuous measurement of Photosynthetically Active Radiation.

Each instrument comes with a complete protocol, illustrated user guides to facilitate field use, and log sheets to standardize the recording of metadata.

To achieve the second objective, we established, in collaboration with the French Navy, the logistical and administrative framework to enable post-Master's students from Sorbonne University to become *Biodiversity Officers* (BiO) equipped to serve the mission Bougainville overseas for a one-year assignment. This process includes the following sequential steps: (*i*)

information sessions for students on the Sorbonne University campus and via social media; (*ii*) submission system for application files; (*iii*) review and selection of candidates by the scientific committee and the French Navy; (*iv*) a three-week training program on scientific protocols; (v) a four-week officer training at the École Navale in Brest to become midshipmen (*aspirants*).

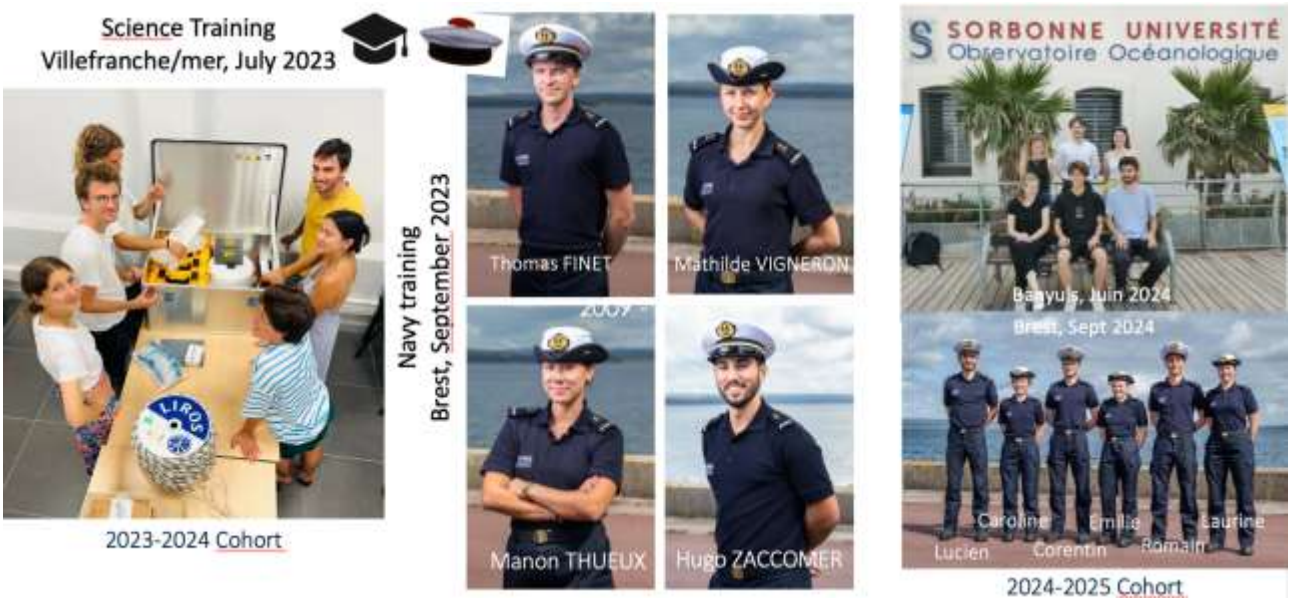

Figure 2. Illustrations of the training of Sorbonne University Master's students to the tools and protocols deployed in mission Bougainville. Satellite data analysis, physical oceanography, and quantitative imaging with the PlanktoScope are taught during a two-week session at the 'Laboratoire Océanographique de Villefranche-sur-Mer'. Training in environmental DNA sampling using the Lamprey system, along with a full protocol dry run at sea, is conducted during a one-week session at the Roscoff Biological Station. Biodiversity Officers then complete their officer training at the Naval Academy in Brest before joining their overseas crews in late autumn.

The *Biodiversity Officer* (BiO) position was specifically created to support Mission Bougainville. Versatile by design, the BiO combines scientific work both at sea and on land with full engagement in the Navy as a midshipman (in French: *aspirant*). At sea, the BiO is responsible for collecting oceanographic and biological data on planktonic ecosystems. On land, they preprocess the collected data and metadata in collaboration with the scientists involved in the program, and advise their counterpart at sea on sampling strategies based on the interpretation of available satellite maps and state of the art data-assimilated models output (e.g. using https://ovl.oceandatalab.com/ and https://data.marine.copernicus.eu/). They also interact with local scientific and environmental communities to exchange data, protocols, and knowledge. As a member of the ship's crew, the BiO supports the captain as a deputy, participates in military drills and operations at sea alongside the rest of the crew, and takes part in sports and other onboard activities. Finally, the BiO plays an

important role in outreach and public engagement: they share observations, the scientific goals and outcomes of the program, and results with the crew, the mission's sponsors, and civil society (see the mission Bougainville news on the website: https://mission-bougainville.fr/actualites/).

To date, 10 BiOs have been recruited and trained: 4 for the 2023–2024 period, and 6 for 2024–2025. The BiOs work in pairs within the crews assigned to each 'Bâtiment de Soutien et d'Assistance Outre Mer (BSAOM - *Overseas Support and Assistance Vessel*), based in Réunion Island (*Champlain*), New Caledonia (*D'Entrecasteaux*), and Tahiti (*Bougainville*).

The third and most important objective of the mission is the execution of biological sampling at sea. This first requires adapting the use of our frugal tools to the configuration of the vessels, and then performing the sequence of actions to be carried out on board —while stationary for the collection of the microbiome using nets and buckets, and while underway, for the processing of samples and the recording of data and metadata (Figure 3).

Given the high level of innovation involved in Mission Bougainville — including the rapid transformation of Master's students into "Biodiversity Officers," close collaboration between scientists and naval personnel, and the deployment of low-tech tools aboard sophisticated military vessels — it took several months to adapt the planned protocols to real-world logistical and operational constraints. Arguably, the most challenging — and most fascinating — aspect of the mission was building mutual understanding between two vastly different cultures: the military and academia. In the research world, the goal is to share information as broadly as possible to harness collective intelligence, even if that often leads to a degree of chaos. In contrast, the military distributes information according to roles and hierarchy to reduce uncertainty and maximize the efficiency of real-world actions. Biodiversity Officers stood at the heart of this complex yet highly complementary cross-cultural exchange. Immersed in an entirely new environment — both culturally and geographically, surrounded by open ocean on the far side of the world — they served as vital bridges between these two worlds despite their relatively young age.

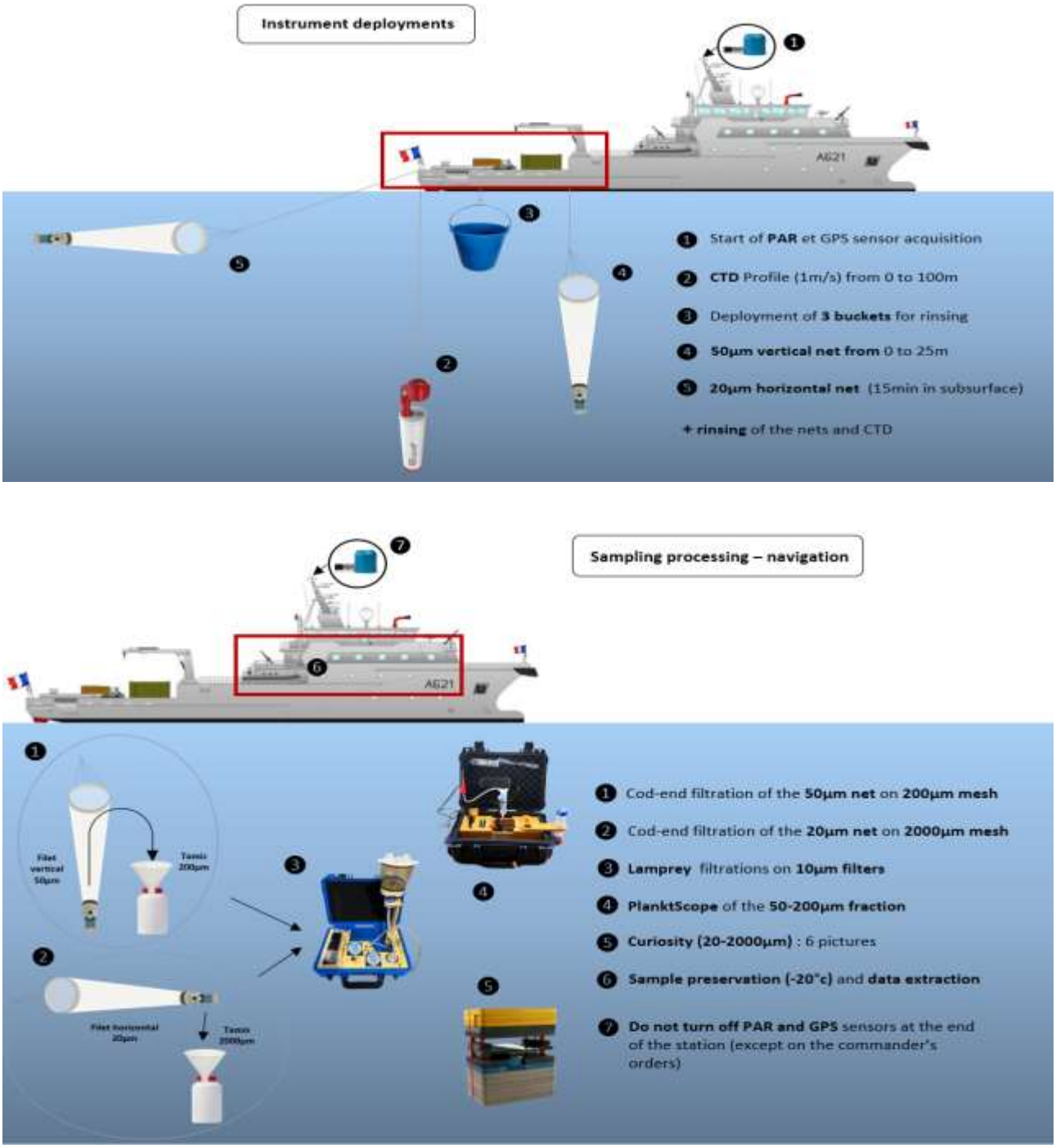

Figure 3: Diagram summarizing the sequence of a sampling station. Top: The vessel is brought to a stop for about 30 minutes to deploy buckets, nets, and the CTD probe in order to collect water, surface plankton and basic physical parameters of the water column. **Bottom:** The sequence of analyses to be performed on the fresh plankton samples once the vessel is back underway. All together, the sampling and analytical parts take c.a. 3 hours.

To ensure consistent and rigorous sampling across sites, vessels, and samplers, we implemented a set of communication and reporting tools, including: (*i*) multiple levels of regular video conferences, ranging from weekly interactions between the BiOs and the Bougainville mission's logistics/field/protocols engineer, to monthly plenary meetings involving researchers, engineers, French Navy personnel, and the logistics team; (*ii*) a sampling strategy meeting ahead of each mission at sea, during which the BiO, the Bougainville engineer, and the ship's commanding officer identify and discuss potential sampling sites; (*iii*) a set of standardized reports and templates to be completed by the BiO during and after each leg of the mission (e.g., metadata files, station maps, preformatted cruise reports, etc.).

As of July 2025, the first 10 BiOs of mission Bougainville had completed surface ocean microbiome sampling at 315 sites (Figure 4). An interactive map of all sampling stations, updated after each Leg, is available at: https://www.google.com/maps/d/edit?mid=1VUVEcvipBZAhFcGVJ7G5ragzrxoPn3w&ll=-4.940847600463577%2C102.92388969984341&z=3

In total, 136 CTD profiles, more than 600 plankton biomass samples for DNA analysis, and 342 samples processed through the PlanktoScope were collected, along with associated environmental metadata and contextual satellite data.

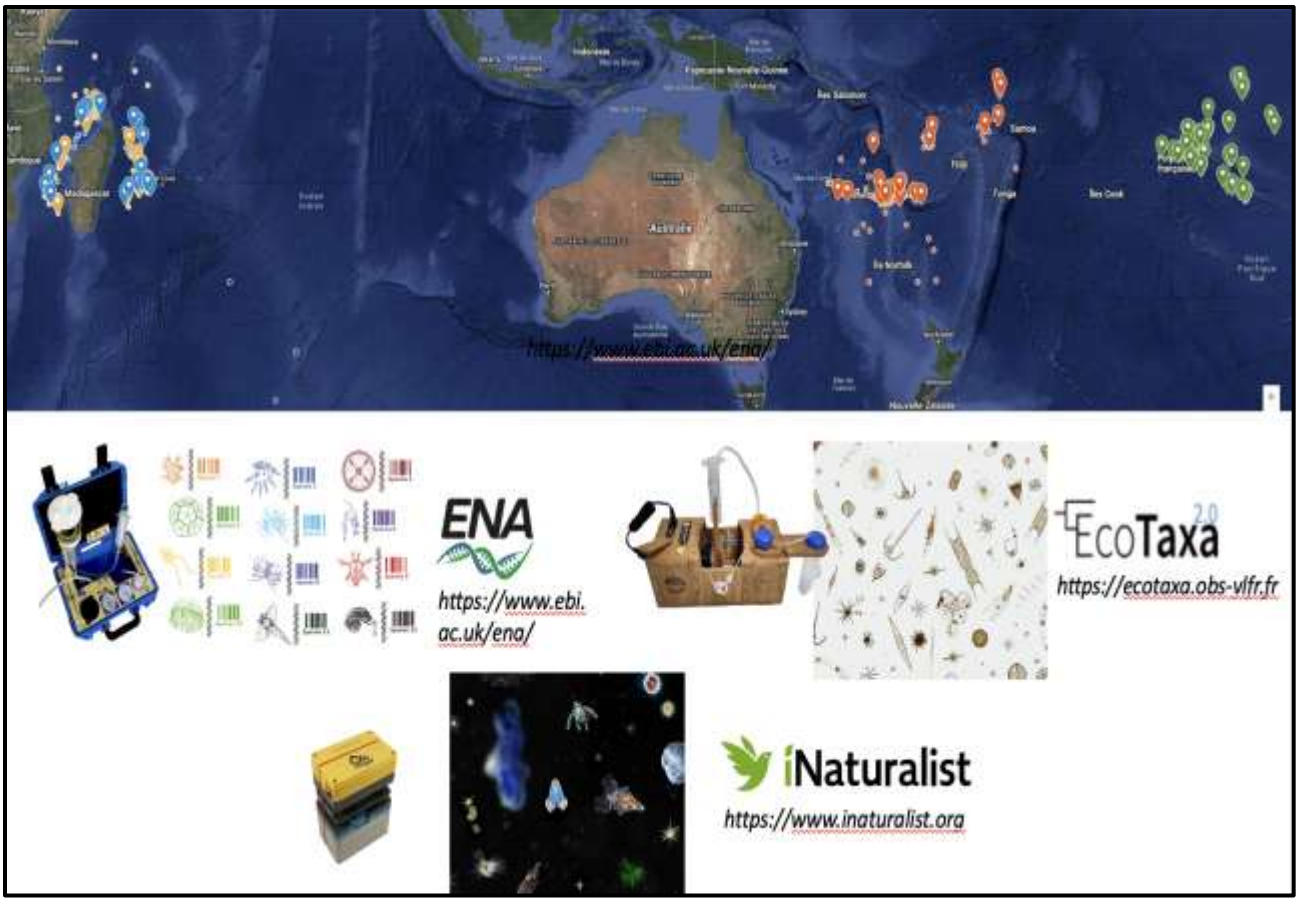

Figure 4: Map of the 315 sampling sites conducted during the mission Bougainville from October 2023 to July 2025. Stations explored by the three BSAOM are colored in yellow, red and green, while additional sites sampled from opportunistic vessels (Astrolabe and Osiris II) in Reunion Island are colored in blue. Plankton biomass samples are dry-ice shipped to the Station Biologique de Roscoff and cryopreserved at -80°C. Raw sequencing data, plankton images acquired automatically with the PlanktoScope and manually with the Curiosity Scope, undergo quality control and are made publicly available through the E*uropean Nucleotide Archive*, the *EcoTaxa* web service, and *iNaturalist*, respectively.

Total DNA has been extracted from the first-season (2023/4) 'Lamprey' samples (n=233). Three marker genes targeting respectively total (Priest et al. Nature Ecology and Evolution, in review), eukaryotic, and metazoan plankton biodiversity were amplified by PCR and are currently being sequenced at *Genoscope*, the French National Sequencing center (c.a. 200K sequence reads/sample). In terms of quantitative imaging, over 900 000 images have been uploaded to the EcoTaxa analytical platform; 315 000 images have been taxonomically annotated and validated by plankton experts.

The findings and the future of Mission Bougainville (2026–2030)

This initial dataset already spans remarkable spatial and temporal scales. Moreover, the integration of Biodiversity Officers within the Navy crews has proven highly positive, as they bring onboard

a new dimension of discovery of the invisible life in ocean water and its implication for the protection of marine ecosystems. A common decision was therefore made that Mission Bougainville would enter a new operational phase of routine and systematic monitoring of the surface ocean microbiome until 2030.

With 6 BiOs trained per year over the next 5 years, in addition to the 10 trained between 2023 and 2025, a total of 40 students will have been made into Biodiversity Officers by 2030. During this time, we will also have explored, sampled, and analyzed the surface ocean microbiome at approximately 2,000 stations, each of them being a unique realization of the ocean ecosystem. This effort will generate the largest consistent and comprehensive dataset on surface ocean plankton biodiversity to date, spanning a significant portion of the Indo-Pacific basin over a multi-year timescale.

Such a corpus of standardized samples and data collected across the Indo-Pacific over a seven-year period will enable the exploration of numerous fundamental and more applied research questions, including:

- **Discovering and inventorying the surface plankton biodiversity** of the (sub)tropical Indian and Pacific Oceans, and establishing a comprehensive reference database of DNA barcodes and images representing this biodiversity.
- **Understanding the biogeographic and ecological distribution** of plankton species, and studying their migration patterns and adaptations in response to environmental factors — particularly those driven by climate change (e.g., warming, acidification, deoxygenation).
- **Revealing plankton interactomes** — the networks of species that, through their complex interactions, function as "super-organisms" and represent the ultimate units of ecology and evolution — using network-based statistical methods. Studying the ecological and evolutionary dynamics of these interactomes.
- **Investigating island mass effects** on plankton ecosystems. The Indo-Pacific basin is packed with islands and seamounts which, through their impact on ocean currents and biogeochemistry, could have unforeseen fertilizing effects on surface plankton communities. The sites sampled by the BSAOMs during Mission Bougainville are located (*i*) along the coast of the Islands, (*ii*) offshore under the island mass effect, and (*iii*) offshore in the oligotrophic background ocean. They form an ideal natural laboratory to understand the strength, drivers, and determinism of island effects on ocean biology and ecology.
- **Enabling the development of next-generation tools to monitor and protect ocean biodiversity and health from space**. Mission Bougainville extensive plankton biodiversity data can be compared to synchronous ocean colour data measured by the new generation of hyperspectral satellites (e.g., PACE, Werdell et al. 2024). This will provide the amount of *in-situ*/remote sensing biodiversity matchup data required for machine learning and AI models to train robust algorithms for predicting plankton biodiversity from space.

- **Understanding and forecasting the links between plankton composition/ecology and the composition/abundance of fish populations**. Plankton feeds and shapes fish communities; a deeper understanding of plankton–nekton biodiversities interactions and co-evolution could enable the use of microbiomes as indicators to monitor and forecast fisheries and fish stocks.

- **Incorporating higher-resolution global-scale plankton biodiversity data into efforts to model** the dynamics and functioning of ocean ecosystems and ocean-climate interactions.

- **Detecting invasive, toxic, or economically relevant plankton species,** as well as **developing universal indexes of ocean health**. Specific planktonic interactomes carry the biological functions that underpin critical ecosystem services enabling higher trophic level species (including humans) to live in good health. A comprehensive and standardized measurement of micro-biodiversity could ultimately lead to the development of simple indices to guide conservation strategies and policy decisions.
- **Assessing dynamical biogeographic zones in the seascapes for optimal design of high seas marine protected areas** (e.g. ecosystems with high capacity for carbon sequestration).

In addition to generating unprecedented datasets, Mission Bougainville and the Plankton Planet initiative aim to create meaningful impacts across local, national, and international levels in several key areas.

Innovative and affordable monitoring solutions. The project is based on cost-effective, robust, and easy-to-use instruments and protocols. These tools can be widely deployed, including in countries of the Global South, paving the way for the democratization of ocean health monitoring. This approach empowers a wide range of stakeholders — NGOs, local researchers, and citizens — to adopt these methods and contribute actively to data collection and generation of universal knowledge.

Strengthening local engagement. By involving local communities, schools, and associations in outreach and scientific activities, the project seeks to foster stronger citizen participation, particularly in overseas territories. For instance, discussions have begun with the *Académie de La Réunion* to develop a citizen-science program focused on plankton for local schools.

Structuring Role of the French Navy. By integrating life-science operations aboard French Navy vessels, the project highlights the military's capacity to contribute meaningfully to scientific knowledge, in alignment with a public service mission. The Navy thus becomes a powerful vector for science dissemination, enabling access to strategic, scientific, and environmental zones that are often otherwise unreachable.

Furthermore, the Bougainville Mission enhances understanding of the ocean environment in which Navy vessels operate while strengthening the seafaring skills of the crews. Traditionally, sailors have focused on collecting physical data about the ocean—such as swell, waves, temperature, salinity, and sound velocity—while rarely gathering biological information. This new angle of

observation will make them more accomplished sailors, capable of perceiving variations in the ocean across both time and space.

In particular, microplankton form the foundation of the oceanic food chain. Monitoring these organisms on a global scale makes it possible to anticipate changes in their diversity and abundance and, consequently, shifts in the distribution and composition of fishery resources. This represents a major environmental, economic, and strategic challenge—one that directly impacts the food security of the three billion people worldwide who rely on fish products.

The vessels engaged in Mission Bougainville are primarily tasked with protecting France's Exclusive Economic Zones. By combining this responsibility with efforts to improve scientific knowledge of the oceans, the mission fulfils a growing expectation among crews who wish to find deeper meaning in their work.

In conclusion, to achieve Plankton Planet's goal of a *seatizen-based standard measure of the ocean microbiome and ocean health across planetary scales*, we propose expanding the Mission Bougainville approach to other naval forces, beginning with the South Pacific Defence cooperation network. This could be implemented through "train-the-trainers" workshops in a navy–academia network (including research and engineering institutions) among countries participating in the South Pacific Defence Ministers' Meeting (SPDMM) — Australia, Chile, Fiji, France, New Zealand, Papua New Guinea, and Tonga. Such a collaboration would lay the groundwork for long-term support in operationalizing a universal microbiome monitoring protocol across a fleet of South Pacific military vessels.

Ultimately, this could lead to the development of a pioneering **Pacific Ocean Health Monitoring Program**, generating essential data and insights to support ocean science, sustainable management, and the blue economy.

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Strategic Competition in the Pacific Islands: An Analysis of Policies and Best Practices from the New Zealand Defence Force and the United States Department of Defense to Address Climate Resilience and Readiness

Paul Holland, New Zealand.

Disclaimer: *The views and opinions expressed in this article are those of the author and do not necessarily reflect the official policy or position of the New Zealand Ministry of Defence or the New Zealand Defence Force.*

Introduction

Climate change is a global challenge that will directly impact the Pacific Islands. The purpose of this article is to highlight how climate change affects the security of the Pacific Island countries and territories. While much of the article focuses on Aotearoa New Zealand and the United States, it addresses the security threat posed by climate change to nations and territories across the Pacific Island region and provides specific recommendations for defence leaders in the Pacific Islands region to consider.

Background

In 2018, leaders from across the region issued the Boe Declaration (Pacific Islands Forum, 2018), which affirmed climate change as "the single greatest threat to the livelihoods, security, and wellbeing of the peoples of the Pacific." In 2022, the Pacific Islands Forum's 2050 Strategy for the Blue Continent re-affirmed the 2018 Boe Declaration and urged collective action on climate change as an issue of significance (Pacific Islands Forum, 2022).

Climate change, along with Strategic Competition (New Zealand Defence Force and Ministry of Defence, 2024), is one of the two principal security challenges facing the Pacific Islands. The NZDF and MOD Statement of Intent (2024) loosely defines the term "Strategic Competition" as states "acting in ways counter to the recognised international rules and norms and advancing competing visions for regional and global orders that are at odds with New Zealand's values and interests." To maintain its status as a trusted ally among Pacific Island countries and territories, Aotearoa New Zealand and other key security partners, must remain committed to climate security and recognize the importance of the issues to the Pacific Islands (Pacific Islands Forum, n.d.).[1] This article identifies the following key problem statement for New Zealand in the context of the

[1] For the purposes of this article, I utilize the terms "Pacific Islands" or "Pacific Island countries and territories." I use these terms interchangeably. These terms refer to the 18 member countries of the Pacific Islands Forum: Australia, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Kiribati, Nauru, New Caledonia, New Zealand, Niue, Palau, Papua New Guinea, Republic of Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu.

Pacific Islands: *losing sight of the impacts of climate change could undermine credibility of partner countries and create space for new actors to expand their influence within the region.*

New Zealand's climate security efforts follow a similar timeline as the Pacific Island Forum. In 2018, the Ministry of Defence (MOD) and Te Ope Kātua o Aotearoa | New Zealand Defence Force (NZDF)[2] jointly published the *Climate Crisis: Defence Readiness and Responsibilities* defence assessment, which concluded that NZDF needs to be positioned to respond to more frequent, possibly concurrent, and more complex security events because of climate change. The following year, in 2019, MOD and NZDF jointly published *Responding to the Climate Crisis: An Implementation Plan,* and New Zealand passed the Climate Change Response (Zero Carbon) Amendment Act. The Act provides a framework by which New Zealand can develop and implement clear and stable climate change policies that:

- Contribute to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5° Celsius above pre-industrial levels;
- Allow New Zealand to prepare for, and adapt to, the effects of climate change.

In the 2023, the NZDF Defence Policy and Strategy Statement identified climate change and strategic competition as the two principal strategic challenges currently facing New Zealand and the Pacific Islands. The statement reiterated the strategic impact of climate change, declaring "addressing the impacts of climate change will be one of the greatest global challenges of coming decades (New Zealand Ministry of Defence, August 2023)." In 2024, NZDF published the Tauākī Whakamaunga Atu | Statement of Intent which covers the period FY 2024/25 to FY 2027/28. The Statement acknowledges that the intensifying impacts of climate change present direct environmental and human security risks (New Zealand Defence Force, August 2024). Most recently, the Defence Capability Plan, published in April 2025, reiterated climate change and strategic competition in the Pacific as key elements of regional security challenges.

Australia is also focused on climate change as the primary security threat to the Pacific Islands. In July 2025, the Australian Parliament published a policy brief (2025), which highlighted the potential security threats associated with climate change. These threats include sea level rise, significant damage to marine ecosystems and economies from ocean heat and acidification, extreme weather events, marine heatwaves, ocean anomalies, heavy rainfall, and severe drought. Low-lying areas in the Indo-Pacific and Pacific small-island states (including Kiribati, Tuvalu, and the Republic of the Marshall Islands) are particular vulnerable.

Since 2000, the United States Department of Defense (DoD) has issued a number of strategies and plans that highlight the increasing levels of concern about climate and the associated security risks as noted by Gleick (2025). These strategies and plans align with DoD's long-standing commitment to working with allies, partners, and like-minded nations in the Indo-Pacific region to uphold a

[2] A note on Māori and English language spelling. For Māori names, I have introduced these at the first mention, including for government agencies and published documents. For English language spelling, I use the New Zealand spelling where appropriate, such as New Zealand *Defence* Forces and Climate Change Response *Programme*. I use the American spelling where appropriate, such as the Department of *Defense*.

free and open region founded on respect for internal rules, laws, and norms. Despite senior DoD leaders recently downplaying the security risks associated with climate change (Waldman and E and E News, 2025), consideration of the effects of climate change are a critical aspect of collaboration between the DoD and Indo-Pacific countries.

Article Structure

This article is adapted from the research report I developed as an Ian Axford Fellow in Public Policy with the Climate Change Response Programme at NZDF. It is the product of a combination of research methods. Over the course of my five months as an Axford Fellow, I conducted an extensive literature review of publicly available documents, visited and met with local experts at five NZDF camps and bases, attended the Te Kōkiringa Taumata | New Zealand Planning Institute Annual Conference, and engaged with thematic experts across the defence and climate change fields in New Zealand and the United States. Finally, this article is informed by my two decades of professional experience as a land use planner supporting senior executives responsible for installation and infrastructure management across the DoD.

The article analyses five focus areas. These focus areas closely align with the "lines of effort" in the DoD Climate Adaptation Plan 2024-2027 (2024). The focus areas were also informed by my professional experience and the research methods detailed above, including the literature review, site visits, and expert meetings. Each of the focus areas identified below includes a discussion and outcome-oriented recommendation sections:

- Data: Identifying cost-effective and consistent data and tools to inform current and future climate decision-making
- Infrastructure Investment: Evaluating existing processes to prioritize climate resilience for operational and built infrastructure projects at bases and camps. This includes how these camps and bases serve as "power projection platforms" from which operations are launched, and strategic objectives achieved
- Engagement: Exploring opportunities for improved collaboration with local stakeholders on climate adaptation and resilience – this could include engagement with local government and indigenous representatives with intergenerational, local, and traditional knowledge
- Policy and Guidance: Highlighting existing opportunities within strategy, policy, and planning governance structures to improve climate resilience
- Education and Training: Advancing an appropriate and tailored approach to climate-related education and training

The recommendations proposed in this article include actions designed to address the key problem statement: losing sight of the impacts of climate change could undermine regional security and create space for new actors to expand their influence in the Pacific Islands. Given the importance of climate change to the Pacific states, New Zealand, and the broader region, would benefit from a stronger commitment to addressing climate change. Such a commitment by key security partners, including NZDF, MOD, and other ministries across the New Zealand government, would strengthen regional stability, advance the interest of militaries throughout the Pacific Islands,

promote New Zealand's values and interests, and address the Pacific Islands Forum's greatest threat: climate change. Future collaboration between the United States and New Zealand on climate change could address strategic competition, reinforce credibility among the Pacific Islands, and reduce opportunities for new strategic competitors to emerge in the region.

Data

As the impacts of climate change increase, it is essential for regional militaries to utilize the best available and accessible climate data to support climate-informed decision-making across the Pacific Islands. Reliable and consistent data is critical for an effective climate change strategy. Without reliable data, government organizations across the Pacific Islands, including New Zealand, will struggle to establish a climate security strategy, assess climate-management actions, track progress, and monitor current and future climate risks. Recent research has identified two key challenges with climate data: gaps in established data sets and 'missing' data (UNDRR, 2023).

Within the Pacific Islands, the Weather Ready Pacific Programme aims at reducing the human and economic cost of severe weather events, protecting Pacific Island communities and economies that are particularly vulnerable to climate change (World Meteorological Organization, 2024). The Programme, which was endorsed by the Pacific Islands Leaders in 2021, envisions the following outcomes over the next decade:

- Comprehensively strengthening the region's hydro-meteorological system with enhanced data
- Underpinning global-standard modelling and enabling strengthened forecasts and warning across the Pacific Islands
- Clearer communication of impacts, which then reach target communities in a timely way
- Data management by technically skilled staff in effective organisations

By improving integration in the global weather monitoring and tracking system, the Pacific Island nations and territories will be more empowered to advocate for their climate interests in global settings (Pacific Meteorological Council, n.d.).

In New Zealand, Defence Science and Technology (DST) is a key climate data actor and provides technical and scientific advice to NZDF and MOD. DST's Information Warfare Division supports efforts to respond to a changing climate, decrease operational risk, and achieve compliance with legislation and regulation. Beyond NZDF and MOD, the National Institute of Water and Atmospheric Research (NIWA) maintains the national climate database for New Zealand. The data includes observational, derived, and spatial data types for three main categories: marine, freshwater, and climate. The Meteorological Service of New Zealand Limited (Met Service) is a state-owned enterprise that provides weather forecasts and related information services to both the public and private-sector clients. Other potential partners within the New Zealand government include the Ministry of Foreign Affairs and Trade (MFAT) and the Climate Change Commission, which conducts research and analysis of the different factors that can affect New Zealand emissions and the potential impacts of climate change.

Policymakers in the United States have sought to address the reliability and consistency issue by standardizing climate data across the DoD. Section 326 of the Fiscal Year (FY) 2020 National Defense Authorization Act (NDAA) authorized the DoD to develop an extreme weather-vulnerability and risk-assessment tool. This tool, known as the DoD Climate Assessment Tool (DCAT), provides United States Military Departments, and their installation personnel with access to consistent exposure data across climate and extreme weather hazards. While DCAT only assesses exposure to climate hazards, and does not assess climate vulnerability (Bewley et al. 2021), it is a consistent and reliable data source. The DoD has historically shared DCAT with key allies, including Australia, and the tool supports efforts to achieve climate resilience for military infrastructure.

Recommendation:

Reliable data will be essential to addressing the climate change challenges facing the Pacific Islands. To avoid the emergence of new actors as a result of heightened strategic competition, New Zealand and the United States could pursue stronger data sharing and outreach to partner nations and territories within the region.

Through the ongoing work of the Weather Ready Pacific Programme, the Pacific Islands nations and territories are well positioned to increase their data knowledge and awareness over the next decade. With this increased data and knowledge, the Pacific Islands region's militaries could consider prioritizing the development of the internal data management processes to track climate impacts. This could include a focus on opportunities for expanded domestic data management and partnerships with international weather data managers. More localized data collection and monitoring could help widen awareness of climate impacts across the Pacific Islands and promote greater collaboration.

Infrastructure Investment

Targeted investment is a key strategy to address climate resilience at military camps and bases within the Pacific Islands. Investing in this infrastructure is essential, as camps and bases provide the foundation from which operations are launched, and strategic objectives achieved. These camps and bases serve as the "power projection platforms" for operational activities.

Within NZDF, the defence estate provides training, working, and living environments that directly enable military operations (New Zealand Defence Force, 2024). As stated in the NZDF annual report (2024), the estate covers 81,000 hectares across nine camps and bases, two large training areas, and various regional support facilities.

The New Zealand Infrastructure Action Plan also identifies NZDF as a key partner in the effort to reduce greenhouse gas emissions. The NZDF Emissions Reduction Plan (2022), sets out a range of initiatives the NZDF is taking to reduce the emission of greenhouse gases. It was developed as a starting point and sets the 'direction of travel' for NZDF on the priority task of addressing the reduction of gross emissions. The Plan includes an action to realize cross-sector opportunities to reduce whole-of-life embodied carbon emissions (Hīkina Whakatutuki | Ministry of Business, Innovation, and Employment, 2020) and opportunities to minimize waste or recovery during the building consent process (New Zealand Government, 2023). The NZDF Emissions Reduction Plan

(2023) calls for the Force to continue application of the NZDF Sustainable Infrastructure Standards. The standards operationalize NZDF's sustainability aspirations into practical, technical expectations which can be integrated into future building design and construction practices. The Emissions Reduction Plan (2023), also states NZDF's usage of the standards should result in emissions reductions in operational energy, electricity and waste emissions, and embodied material and construction emissions.

The DoD has also recognized the challenges associated with infrastructure resilience. In December 2024, the DoD issued DoD Instruction 4715.28, Military Installation Resilience (2024). This instruction directs the military departments to consider "all-hazard resilience" in design and construction when facilities are sustained, repaired, and modernized. To achieve climate resilience, the Instruction directs the prioritization of materials that reduce carbon footprint, increase structural life cycle, reduce maintenance costs, and reduce energy demand.

In addition the strategic approach adopted by NZDF and DoD, both organizations are pursuing tactical actions to address camps and base resilience. The Defence Estate Climate Adaptation Plans (DECAP) represent a tailored approach to adaptation planning which combines best practice process elements from Manatū Mō Te Taiao | Ministry for the Environment guidance and NZDF Defence Force Order 081 – Risk Management (2019). These documents provide the policy foundation to understand, describe, assess, and plan to adapt for risks posed by climate hazards at each major NZDF camp, base, and training area.

The DECAP successfully integrates compelling visual graphics to establish the narrative around climate change at NZDF camps and bases. In particular, the DECAP's Dynamic Adaptive Pathway Plan (DAPP) methodology enables a flexible approach and assesses each pathway over time, including costs associated with changing course when options can no longer meet the stated objectives. DAPP also enables decisions to be reviewed and re-evaluated, by first setting objectives, then deciding thresholds for future actions, and allowing sufficient time to implement response options. Future resilience planning throughout the Pacific Islands could benefit from applying the additional analytical rigour of the DAPP methodology to evaluate future pathways and responses to extreme weather exposure as outlined in New Zealand Ministry for the Environment's publication, Preparing for Coastal Change: A Summary of Coastal Hazards and Climate Change Guidance for Local Government.

Beyond domestic infrastructure considerations, as those discussed above, dual-use infrastructure development could directly impact strategic competition in the Pacific Islands. Recently, scholars have argued that actors looking to expand their influence in the Pacific Islands are funding and developing assets (including ports, fisheries, aviation, and digital infrastructure) that could be weaponised to achieve strategic objectives. Dual-use infrastructure could be utilized as a force multiplier and could disrupt joint mobilization among regionals actors (I-Kwei Yang, D, 2025).

Recommendation

Defence Forces in the South Pacific could consider integrating climate resilience as a criterion for future acquisition and funding prioritization processes. As outlined in NZDF Doctrine (2017), this includes both the Multi-Criteria Decision Analysis for future funding priorities and the military

capability components of PRICIE: personnel; research and development; infrastructure and organisations; concepts, doctrine, and training; information technology; and equipment, logistics, and resources.

Specifically, NZDF could provide a template for integrating the Multi-Criteria Decision Analysis criteria set in the next iteration of its Defence Estate Regeneration Implementation Plan (2019). By including climate resilience criteria, such as the prioritization of materials that reduce carbon footprint, increasing structural life cycle of new facilities, reducing maintenance cost, and reducing energy demand. If NZDF updates this Multi-Criteria Decision Analysis criteria set, it could work closely with partner nations in the Pacific Islands region to share their outcomes and findings from the update. Additionally, NZDF could consider providing templates and capacity building support for the analytically rigorous DECAPs to strategic partners in the Pacific Islands. These documents could help Pacific partners better understand the climate vulnerabilities of their military and defence infrastructure.

Military camps and bases throughout the Pacific Islands could also benefit from the increased investment by bilateral partners and multilateral development banks. This increased investment could help address a shared infrastructure challenge: vulnerability to the impacts of climate change, including sea level rise and more extreme weather events. As future investments are prioritized, collaboration on climate resilience will assist organizations, including those in defence, throughout the region.

Engagement

Strong collaboration with external stakeholders, including indigenous communities and non-governmental organizations, on adaptation and resilience projects, will enhance the Pacific Island's response to the climate crisis. It is essential for military leaders in the Pacific Islands to engage with and understand the needs of their host communities and value the importance of intergenerational, local, and traditional knowledge. These partnerships will present new opportunities to address climate security impacts within the region.

During my Axford Fellowship in early 2025, I conducted five site visits to NZDF Bases and Camps. These included Devonport Naval Base, Waiouru Military Camp and Training Area, Burnham Military Camp, Royal New Zealand Air Force (RNZAF) Base Ohakea, and RNZAF Base Auckland Whenuapai. I also met with community leaders in Palmerston North, the host community for Linton Military Camp. Through these site visits and local expert meetings, NZDF staff and uniformed leaders discussed ongoing engagement efforts with local communities to manage the impacts associated with climate change.

NZDF has many successful examples of community partnerships. At Base Ohakea, the Sanson Playground was constructed in 2019 and is the result of a collaboration among the Sanson Community Committee, Manawatū District Council, and NZDF. As the host community for Ohakea, the Sanson community designed the playground to resemble the popular Air Force Skyhawk plane and Base Ohakea runway (Mitchell, 2019). In Palmerston North, the recently developed He Ara Kotahi pathway and cycle trail is a mixed-use trail developed jointly by the Palmerston North council, Massey University, and Linton Military Camp. The trail connects

Palmerston North with Linton Military Camp, providing safer and shorter access between these locations while reducing vehicle emissions. These types of collaborations provide a template for future adaptation, emissions reduction, and climate resilience projects and can help build a foundation of trust between NZDF and local stakeholders.

Within the United States Department of the Air Force (DAF), the Air Force Community Partnership (AFCP) Program promotes collaboration between military installations and their host communities to address shared challenges. Through the AFCP program, leaders can leverage unique capabilities that enhance mission performance, reduce overall costs, and improve quality of life for DAF Airmen and their families. Recent success stories include a water conservation collaboration between Cannon Air Force Base, New Mexico, and surrounding communities to advance sustainable land use practices across forestry and agricultural lands while saving 12 billion gallons of water over three years. In addition to partnership opportunities, military leaders across the Pacific Islands would benefit from utilizing existing resources from the DoD, such as the Commander's Guide to Community Involvement (2022). This guide provide examples for military leaders to consider and develop tools and information about effectively working with communities to help protect and strengthen the military missions.

Creating synergies between indigenous culture, Māori in New Zealand, and military culture can enable a positive partnerships with government entities, something that has been replicated within NZDF (Scoppio, 2018). Successful examples of engagement include integrating the Māori warrior ethos as part of the Army ethos, creating Marae – the courtyard of Māori meeting house, especially as a social and ceremonial forum – on NZDF camps and bases, instituting Māori cultural advisors, offering Māori language classes, and developing the Te Waharoa app as the gateway to Māori Language and protocols. In April 2023, NZDF published Kia Eke, the Māori Strategic Framework. This document commits NZDF to be a bi-cultural organization and places Te Tiriti o Waitangi | The Treaty of Waitangi at the heart of NZDF efforts to strengthen engagement efforts, value Māori contributions to NZDF, and empower NZDF personnel. Kia Eke (2023) commits to creating a positive, healthy, and safe environment within NZDF and highlights the role NZDF can play, both internally and externally, to deliver positive outcomes through the Iwi and Hapū where NZDF camps, bases, and places of work are located.

In Māori tradition, Māori self-define as tāngata whenua (people of the land), a status that is formally recognized in New Zealand legislation. Māori culture, society, and spiritual domains are centred around land and natural resources, including the marine environment (Lockhart, et al. 2019). This deep connection between Māori and the land could be reflected in future efforts to address climate change at NZDF bases and camps.

Recommendation

Leaders across the Pacific Islands should continue hold regular meetings, such as the South Pacific Defence Ministers Meeting, and engage with key stakeholders to share ideas and best practices on climate change the associated security impacts related to Strategic Competition. There are significant existing resources available, including from the DoD, on successful community engagement and partnerships to address shared challenges. By utilizing these resources, military

leaders in the Pacific Islands could explore opportunities for community partnerships, similar to the examples cited above, to strengthen trust and address climate impacts.

By utilizing the example provided by NZDF with their Kia Eke strategy, Pacific Island militaries could strengthen the connection between climate change and indigenous and traditional knowledge. Future generations could benefit from acknowledging of the importance of land, natural resources, and the marine environment within indigenous culture, society, and spiritual domains, as well as the impact that climate change will have on the security of these domains.

Policy and Guidance

Established strategy, policy, and planning governance structures are essential for defence organizations to address climate-related security challenges. Both NZDF and DoD have established risk management policies that are applied to climate. The NZDF risk management process is outlined in NZDF Defence Force Instruction (DFI) 0.81 – Risk Management. Future operational assessments could utilize the same risk management framework. In the United States, the DAF has utilized a similar methodology to apply their established risk management framework to both operational and infrastructure challenges associated with climate resilience. The DAF utilizes an established risk framework, applicable across the Air Force enterprise, to evaluate the impact of climate change on operations and infrastructure. The DAF Instruction 90-802, Risk Management, provides the policy framework and establishes the requirement to integrate and sustain risk management throughout the DAF as a risk reduction process (United States Department of the Air Force, 2024).

Recent policy updates, including to New Zealand Defence Force Orders (DFOs), incorporate climate change and resilience policy considerations. DFO 043 – Estate and Infrastructure, which was published in May 2024, requires the implementation of a sustainability framework that incorporates sustainability principles. Climate change is one such principle. For logistics, DFO 40 – Defence Logistics, addresses risk and resilience considerations related to climate change. These guidance documents establish leadership priorities and provide the foundation for integrating climate considerations across the organization.

NZDF also established the Climate Change Response Programme (CCRP) board in 2021 (New Zealand Defence Force Media Centre, 2023), which is chaired by a senior officer within NZDF. There is a similar governance board within the DAF. The Senior Leader Climate Forum, chaired by the Assistant Secretary of the Air Force for Energy, Installations, and Environment, was designated as the primary governance board for the climate. The DAF Senior Leader Climate Forum charter, which was approved in September 2022, established the scope, membership, roles and responsibilities, as well as a meeting schedule for the Forum. The Forum's responsibilities include:

- Providing oversight and monitoring of the DAF's climate efforts
- Ensuring climate actions are consistent with DAF policy
- Establishing direction and priorities for climate-related objectives
- Providing guidance to climate-focused working groups, and

- Assuring consistent climate-related communication

Like the Senior Leader Climate Forum, the CCRP Board provides oversight of climate programmes and plays a key role in advancing leadership priorities.

Recommendation

NZDF could support Pacific Islands partner militaries by providing sample documents, including Defence Force Orders and Defence Force Instructions as templates to strengthen climate governance structures. To develop a comprehensive and adaptive response to climate change, military organisations in the Pacific Islands could consider establishing a climate change working group to formalize climate reporting processes, advance programme management objectives, and ensure consistent budget resources and funding support to address climate change. There are past examples, including the governance documents for the NZDF's CCRP Board and the DAF's Senior Leader Climate Forum, which could serve as templates for governance structures.

Education and Training

Climate-related education and training resources are essential to building and strengthening climate resilience capacity within a defence organization. To enhance this capability, Pacific Island militaries could focus on growing the knowledge, skills, and capabilities of its uniformed and civilian staff. Within the DoD, climate literacy (Department of Defense, Office of the Undersecretary of Defense (Acquisition and Sustainment), 2022) has been integral to past climate adaptation efforts and directly linked with climate-informed decision-making (Department of Defense, Office of the Undersecretary of Defense (Acquisition and Sustainment), 2024).

Within NZDF, the New Zealand Defence College (NZDC) provides personnel with opportunities to gain skills, knowledge, and qualifications for military and post-military careers. NZDC oversees a centralized programme management system to provide a repository for programme development, lesson planning, and delivery resources.[3] NZDC recently developed a comprehensive learning management system which enables service personnel to engage with programmes in an online environment. These resources are available to personnel through the Defence Learning Management System. The online learning modules provide NZDF personnel with a general understanding of their roles and responsibilities related to a specific topic.

Similarly, in the United States, the DoD previously devoted significant resources to expanding climate literacy across the Department. In January 2022, the DoD established the Climate Literacy Sub-Working Group, which was tasked with integrating climate considerations into DoD education and training. The Working Group reached a consensus definition of climate literacy to inform DoD education, training, and engagement activities. Specific DoD efforts included educating both service members and civilians, hosting focus groups to evaluate current knowledge levels, and utilizing climate literacy when promoting workforce development and talent management.

[3] External Evaluation and Review Report: New Zealand Defence Force (18 October 2022).

Within the Pacific Islands, the South Pacific Defence Ministers Meeting (SPDMM) community has established a Regional Training Framework (RTF). The RTF is a online platform, which allows SPDMM members to exchange information and share resources on military and defence civilian training topics. The RTF provides a consolidated online course library that enhances two-way feedback to ensure training is aligned to the needs to the South Pacific Defence community. As of May 2025, the prototype website was launched and in consultation with SPDMM members (Regional Training Framework, n.d.).

Recommendation

To improve awareness among the Pacific Islands military personnel, New Zealand could conduct voluntary, climate-literacy training sessions with military personnel in partner nations. These training sessions could help establish a baseline of current climate knowledge across the Pacific Island nations and territories, identify existing knowledge gaps, and solicit recommendations for future climate-related training content.

In addition to updating existing training resources, NZDF could amplify the impact of training resources by making these available through the SPDMM Regional Training Framework. The RTF could serve as a tool to disseminate newly developed training modules to support climate literacy for military forces across the region. A general climate education module, available online, would provide the benefit of awareness on one of the key strategic drivers within the Pacific Islands region. Such training could target individual military members to ensure a climate-literate workforce that can prepare for, mitigate the effect of, adapt to, and recover from climate impacts to military missions and operations in the Pacific Islands.

Conclusion

The 2018 Boe Declaration established climate change as the single greatest threat to the livelihoods, security, and wellbeing of the peoples of the Pacific Islands. This position was reaffirmed in 2022 through the 2050 Strategy for the Blue Continent.

In response to the climate threat, the New Zealand government and NZDF have highlighted the strategic role of climate change in the region. Both the 2024 Statement of Intent and the 2025 Defence Capability Plan, published in April 2025, highlight the regional importance of climate and how it could cause critical challenges for Pacific Island countries and territories and directly exacerbate other security issues. Given the importance of climate change to the Pacific states, New Zealand, and the broader region would benefit from a stronger commitment to addressing climate change. Implementing the recommendations outlined this article would help strengthen regional stability, promote New Zealand's values and interests, and address the Pacific Islands Forum's greatest threat: climate change. Future collaboration among New Zealand and key partners in the South Pacific on climate change should address strategic competition, reinforce New Zealand's credibility among the Pacific Islands, and reduce opportunities for new strategic competitors to emerge in the region.

This article has framed the climate challenge facing the Pacific Islands, provided some examples of both ongoing and potential actions that militaries, including NZDF, could undertake to improve

regional collaboration on climate change, and listed a series of relevant recommendations for policymakers both in New Zealand and across the Pacific Islands.

Despite evolving political considerations, climate change remains an existential concern for the Pacific Islands. Losing sight of the impacts of climate change could result in the emergence of new actors and a rebalancing in the strategic competition dynamic within the region.

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