<u>Agenda Item No. 18.3</u>: Impacts of Climate Change for the Pacific According to the Latest Findings of the Intergovernmental Panel on Climate Change (IPCC) and Future Priorities of the IPCC

Annex 1: Impacts of Climate Change for Small Islands**

Current and future climate-related drivers of risk for small islands during the 21st century include sea level rise (SLR), tropical and extratropical cyclones, increasing air and sea surface temperatures, and changing rainfall patterns (*high confidence*; *robust evidence*, *high agreement*). {WGI AR5 Chapter 14; Table 29-1} Current impacts associated with these changes confirm findings reported on small islands from the Fourth Assessment Report (AR4) and previous IPCC assessments. The future risks associated with these drivers include loss of adaptive capacity {29.6.2.1, 29.6.2.3} and ecosystem services critical to lives and livelihoods in small islands. {29.3.1-3}

SLR poses one of the most widely recognized climate change threats to low-lying coastal areas on islands and atolls (*high confidence*; *robust evidence*, *high agreement*). {29.3.1} It is virtually certain that global mean SLR rates are accelerating. {WGI AR5 13.2.2.1} Projected increases to the year 2100 (RCP4.5: 0.35 m to 0.70 m) {WGI AR5 13.5.1; Table 29-1} superimposed on extreme sea level events (e.g., swell waves, storm surges, El Niño-Southern Oscillation) present severe sea flood and erosion risks for low-lying coastal areas and atoll islands (high confidence). Likewise, there is high confidence that wave over-wash of seawater will degrade fresh groundwater resources {29.3.2} and that sea surface temperature rise will result in increased coral bleaching and reef degradation. {29.3.1.2} Given the dependence of island communities on coral reef ecosystems for a range of services including coastal protection, subsistence fisheries, and tourism, there is high confidence that coral reef ecosystem degradation will negatively impact island communities and livelihoods.

Given the inherent physical characteristics of small islands, the AR5 reconfirms the high level of vulnerability of small islands to multiple stressors, both climate and non-climate (*high confidence*; *robust evidence*, *high agreement*). However, the distinction between observed and projected impacts of climate change is often not clear in the literature on small islands (high agreement). {29.3} There is evidence that this challenge can be partly overcome through improvements in baseline monitoring of island systems and downscaling of climatemodel projections, which would heighten confidence in assessing recent and projected impacts. {WGI AR5 9.6; 29.3-4, 29.9}

Small islands do not have uniform climate change risk profiles (*high confidence*). Rather, their high diversity in both physical and human attributes and their response to climate-related drivers means that climate change impacts, vulnerability, and adaptation will be variable from one island region to another and between countries in the same region. {Figure 29-1; Table 29-3} In the past, this diversity in potential response has not always been adequately integrated in adaptation planning.

** *Source: Nurse, L.A., R.F. McLean, J. Agard, L.P. Briguglio, V. Duvat-Magnan, N. Pelesikoti, E. Tompkins, and A. Webb, 2014: Small islands. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1613-1654.*

There is increasing recognition of the risks to small islands from climate-related processes originating well beyond the borders of an individual nation or island. Such transboundary processes already have a negative impact on small islands (high confidence; robust evidence, medium agreement). These include air-borne dust from the Sahara and Asia, distant-source ocean swells from mid to high latitudes, invasive plant and animal species, and the spread of aquatic pathogens. For island communities the risks associated with existing and future invasive species and human health challenges are projected to increase in a changing climate. {29.5.4}

Adaptation to climate change generates larger benefit to small islands when delivered in conjunction with other development activities, such as disaster risk reduction and community-based approaches to development (*medium confidence*). {29.6.4} Addressing the critical social, economic, and environmental issues of the day, raising awareness, and communicating future risks to local communities {29.6.3} will likely increase human and environmental resilience to the longer term impacts of climate change. {29.6.1, 29.6.2.3; Figure 29-5}

Adaptation and mitigation on small islands are not always trade-offs, but can be regarded as complementary components in the response to climate change (*medium confidence*). Examples of adaptation-mitigation interlinkages in small islands include energy supply and use, tourism infrastructure and activities, and functions and services associated with coastal wetlands. The alignment of these sectors for potential emission reductions, together with adaptation, offer co-benefits and opportunities in some small islands. {29.7.2, 29.8} Lessons learned from adaptation and mitigation experiences in one island may offer some guidance to other small island states, though there is low confidence in the success of wholesale transfer of adaptation and mitigation options when the local lenses through which they are viewed differ from one island state to the next, given the diverse cultural, socioeconomic, ecological, and political values. {29.6.2, 29.8}

The ability of small islands to undertake adaptation and mitigation programs, and their effectiveness, can be substantially strengthened through appropriate assistance from the international community (*medium confidence*). However, caution is needed to ensure such assistance is not driving the climate change agenda in small islands, as there is a risk that critical challenges confronting island governments and communities may not be addressed. Opportunities for effective adaptation can be found by, for example, empowering communities and optimizing the benefits of local practices that have proven to be efficacious through time, and working synergistically to progress development agendas. {29.6.2.3, 29.6.3, 29.8}

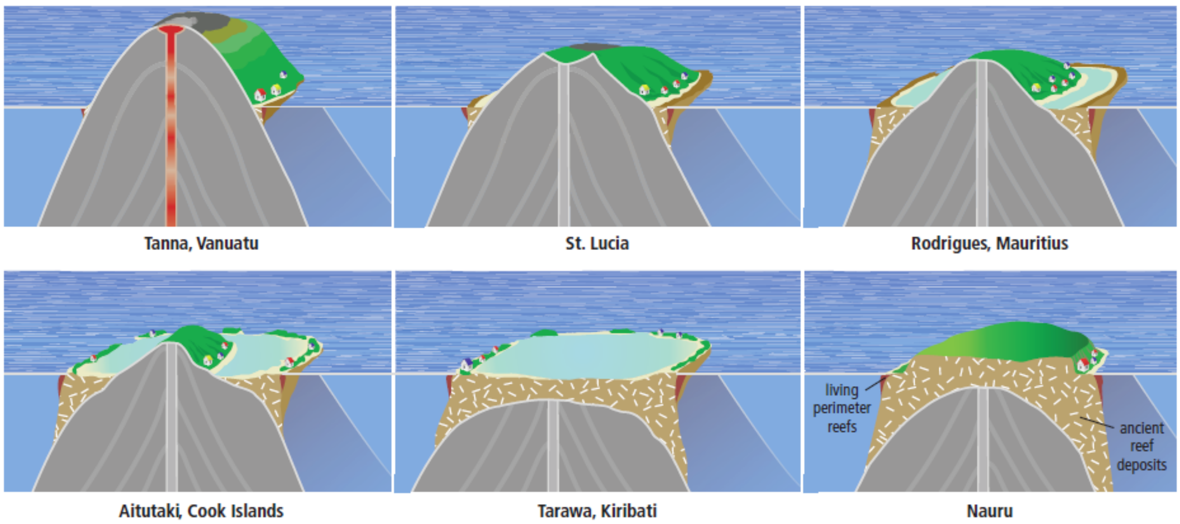

Figure 29-1 | Representative tropical island typologies. From top left: A young, active volcanic island (with altitudinal zonation) and limited living perimeter reefs (red zone at outer reef edge), through to an atoll (center bottom), and raised limestone island (bottom right) dominated by ancient reef deposits (brown + white fleck). Atolls have limited, low-lying land areas but well developed reef/lagoon systems. Islands composed of continental rocks are not included in this figure, but see Table 29-3.

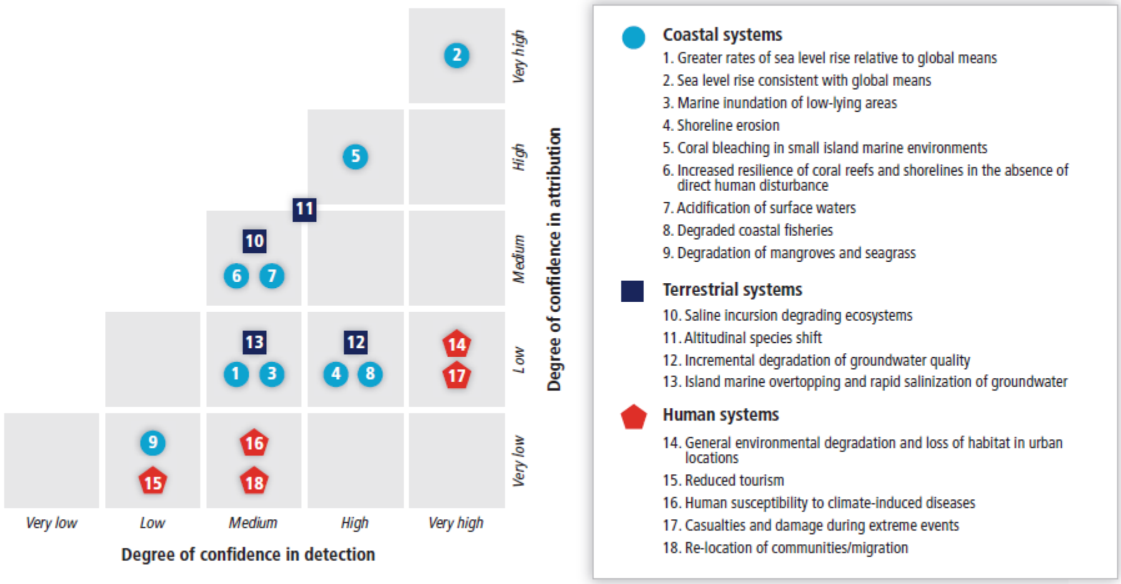

Figure 29-2 | A comparison of the degree of confidence in the detection of observed impacts of climate change on tropical small islands with the degree of confidence in attribution to climate change drivers at this time. For example, the blue symbol No. 2 (Coastal Systems) indicates there is *very high confidence* in both the detection of "sea level rise consistent with global means" and its attribution to climate change drivers; whereas the red symbol No. 17 (Human Systems) indicates that although confidence in detection of "casualties and damage during extreme events" is *very high*, there is at present *low confidence* in the attribution to climate change. It is important to note that *low confidence* in attribution frequently arises owing to the limited research available on small island environments.

Table 29-3 | Types of island in the Pacific region and implications for hydro-meteorological hazards (after Campbell, 2009).

Island type and size		Island elevation, slope, rainfall	Implications for hazard
Continental	• Large • High biodiversity • Well-developed soils	• High elevations • River flood plains • Orographic rainfall	River flooding more likely to be a problem than in other island types. In Papua New Guinea, high elevations expose areas to frost (extreme during El Niño).
Volcanic high islands	• Relatively small land area • Barrier reefs • Different stages of erosion	• Steep slopes • Less well-developed river systems • Orographic rainfall	Because of size, few areas are not exposed to tropical cyclones. Streams and rivers are subject to flash flooding. Barrier reefs may ameliorate storm surge.
Atolls	• Very small land area • Small islets surround a lagoon • Larger islets on windward side • Shore platform on windward side • No or minimal soil	• Very low elevations • Convectional rainfall • No surface (fresh) water • Ghyben–Herzberg (freshwater) lens	Exposed to storm surge, "king" tides, and high waves. Narrow resource base. Exposed to freshwater shortages and drought. Water problems may lead to health hazards.
Raised limestone islands	• Concave inner basin • Narrow coastal plains • No or minimal soil	• Steep outer slopes • Sharp karst topography • No surface water	Depending on height, may be exposed to storm surge. Exposed to freshwater shortages and drought. Water problems may lead to health hazards.

Frequently Asked Questions

FAQ 29.2 | Why is the cost of adaptation to climate change so high in small islands?

Adaptation to climate change that involves infrastructural works generally requires large up-front overhead costs, which in the case of small islands cannot be easily downscaled in proportion to the size of the population or territory. This is a major socioeconomic reality that confronts many small islands, notwithstanding the benefits that could accrue to island communities through adaptation. Referred to as "indivisibility" in economics, the problem can be illustrated by the cost of shore protection works aimed at reducing the impact of sea level rise. The unit cost of shoreline protection per capita in small islands is substantially higher than the unit cost for a similar structure in a larger territory with a larger population. This scale-reality applies throughout much of a small island economy including the indivisibility of public utilities, services, and all forms of development. Moreover, the relative impact of an extreme event such as a tropical cyclone that can affect most of a small island's territory has a disproportionate impact on that state's gross domestic product, compared to a larger country where an individual event generally affects a small proportion of its total territory and its GDP. The result is relatively higher adaptation and disaster risk reduction costs per capita in countries with small populations and areas—especially those that are also geographically isolated, have a poor resource base, and have high transport costs.

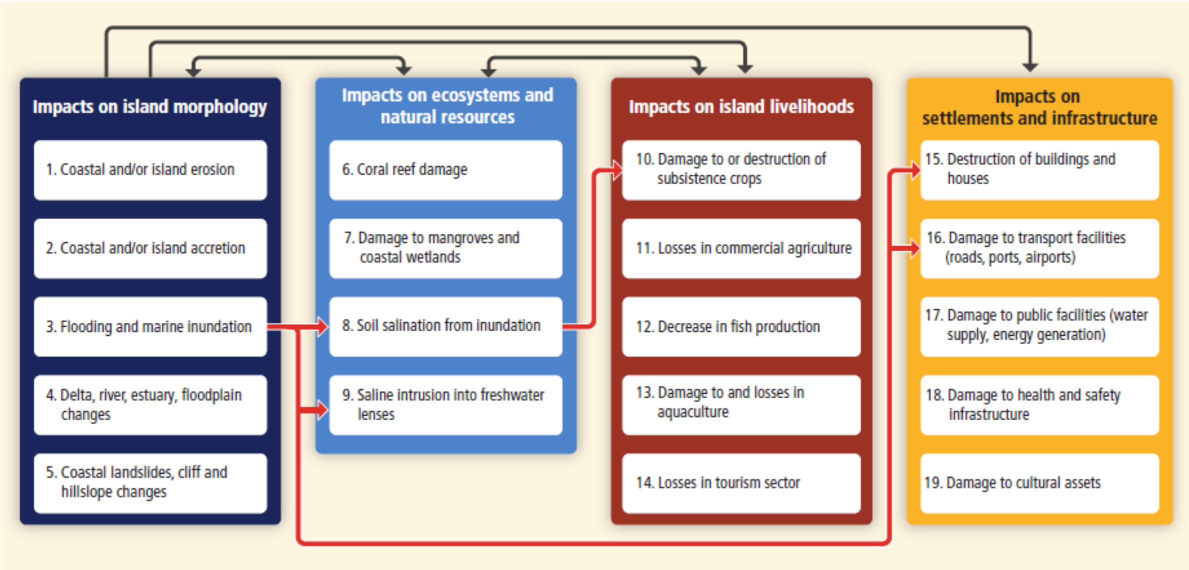

Figure 29-4 | Tropical and extratropical cyclone (ETC) impacts on the coasts of small islands. Four types of impacts are distinguished here, with black arrows showing the connections between them, based on the existing literature. An example of the chain of impacts associated with two ETCs centered to the east of Japan is illustrated by the red arrows. Swell waves generated by these events in December 2008 reached islands in the southwest Pacific and caused extensive flooding (3) that impacted soil quality (8) and freshwater resources (9), and damaged crops (10), buildings (15), and transport facilities (16) in the region (example based on Hoeke et al., 2013).

Table 29-4 | Selected key risks and potential for adaptation for small islands from the present day to the long term.

Climate-related drivers of impacts								Level of risk & potential for adaptation
Warming trend	Extreme temperature	Drying trend	Extreme precipitation	Damaging cyclone	Sea level	Ocean acidification	Sea surface temperature	Potential for additional adaptation to reduce risk; Risk level with **high** adaptation; Risk level with **current** adaptation

Key risk	Adaptation issues & prospects	Climatic drivers	Timeframe	Risk & potential for adaptation
Loss of livelihoods, coastal settlements, infrastructure, ecosystem services, and economic stability (*high confidence*) [29.6, 29.8, Figure 29-4]	• Significant potential exists for adaptation in islands, but additional external resources and technologies will enhance response. • Maintenance and enhancement of ecosystem functions and services and of water and food security • Efficacy of traditional community coping strategies is expected to be substantially reduced in the future.		Present Near term (2030–2040) Long term (2080–2100) 2°C / 4°C	Very low – Medium – Very high
Decline and possible loss of coral reef ecosystems in small islands through thermal stress (*high confidence*) [29.3.1.2]	Limited coral reef adaptation responses; however, minimizing the negative impact of anthropogenic stresses (ie: water quality change, destructive fishing practices) may increase resilience.		Present Near term (2030–2040) Long term (2080–2100) 2°C / 4°C	Very low – Medium – Very high
The interaction of rising global mean sea level in the 21st century with high-water-level events will threaten low-lying coastal areas (*high confidence*) [29.4, Table 29-1; WGI AR5 13.5, Table 13.5]	• High ratio of coastal area to land mass will make adaptation a significant financial and resource challenge for islands. • Adaptation options include maintenance and restoration of coastal landforms and ecosystems, improved management of soils and freshwater resources, and appropriate building codes and settlement patterns.		Present Near term (2030–2040) Long term (2080–2100) 2°C / 4°C	Very low – Medium – Very high