‘NextGen’ Projections for the Western Tropical Pacific: Current and Future Climate for Vanuatu

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Introduction

Photo credit: Anetone Sagaga

- The Australia-Pacific Climate Partnership (APCP) funded a project called ‘Next Generation Climate Projections for the Western Tropical Pacific’
- It covered 14 Pacific Island countries plus Timor-Leste
- The aim was to provide the latest climate change information in the form of science-based services to key stakeholders, including governments, national meteorological services, sectors, regional organisations, universities, consultants, international donors and other development partners
- These services inform climate-related policy development, impact/risk assessments, adaptation planning, disaster risk management and associated decision-making
- The reports, guidance, case studies and other communication and knowledge brokering products are available at **www.rccap.org**

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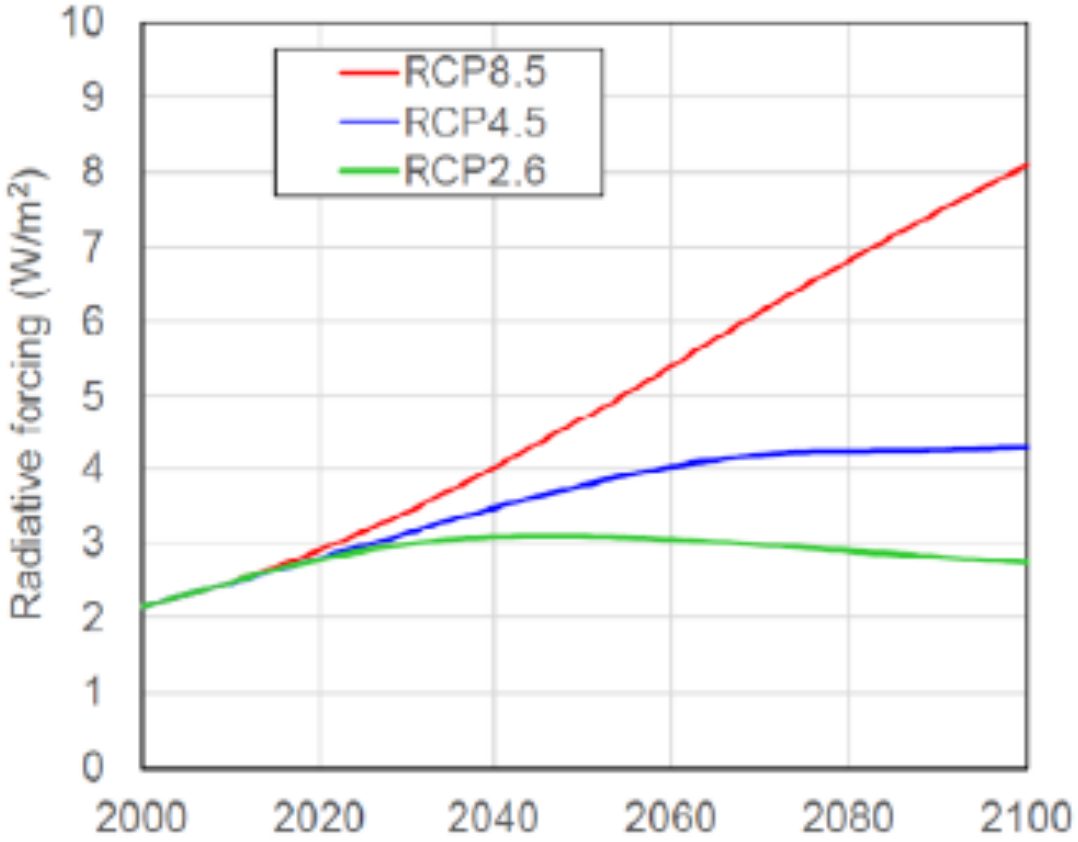
Historical and projected climate change



Source: CSIRO & SPREP 2021, Figure 8.1

- Historical climate change is assessed for Vanuatu using 5 temperature datasets, 2 rainfall datasets, 3 sea level datasets and 1 cyclone dataset
- Projected climate change for the Pacific is assessed for low (RCP2.6), medium (RCP4.5) and high (RCP8.5) global emission pathways (see opposite)
- Up to 36 CMIP5 climate models simulate future global climate change for each emission pathway
  - the low emission pathway gives a global warming of about 2°C
  - the high emission pathway gives a global warming of about 4°C
- CMIP5 climate projections for the Pacific including Vanuatu have been assessed with an appropriate, scientifically validated subset of these models
- The IPCC Sixth Assessment WG1 Report (2021) has also now released the latest CMIP6 global climate model simulations from around the world, which will become the new standard for the western Pacific once they are fully evaluated at the regional to sub-regional/national scale

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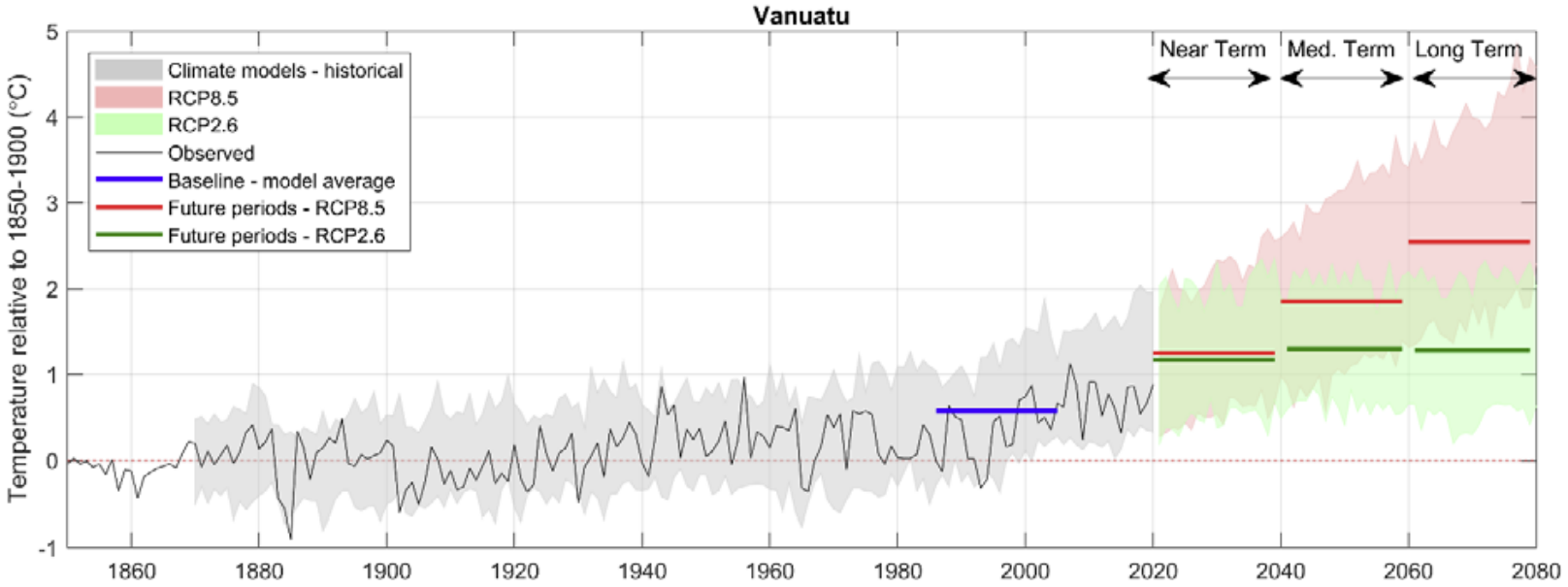
Historical and projected changes in temperature



Source: CSIRO & SPREP 2021, Figure 2.6

- Vanuatu warmed by 0.7°C up to 2011-2020, relative to the pre-industrial baseline of 1850-1900
- By 2030, the warming is 1.2°C relative to 1850-1900, regardless of the emission pathway
- By 2050, the warming is 1.3°C (RCP2.6) to 1.9°C (RCP8.5), relative to 1850-1900
- By 2070, the warming is 1.3°C (RCP2.6) to 2.6°C (RCP8.5), relative to 1850-1900

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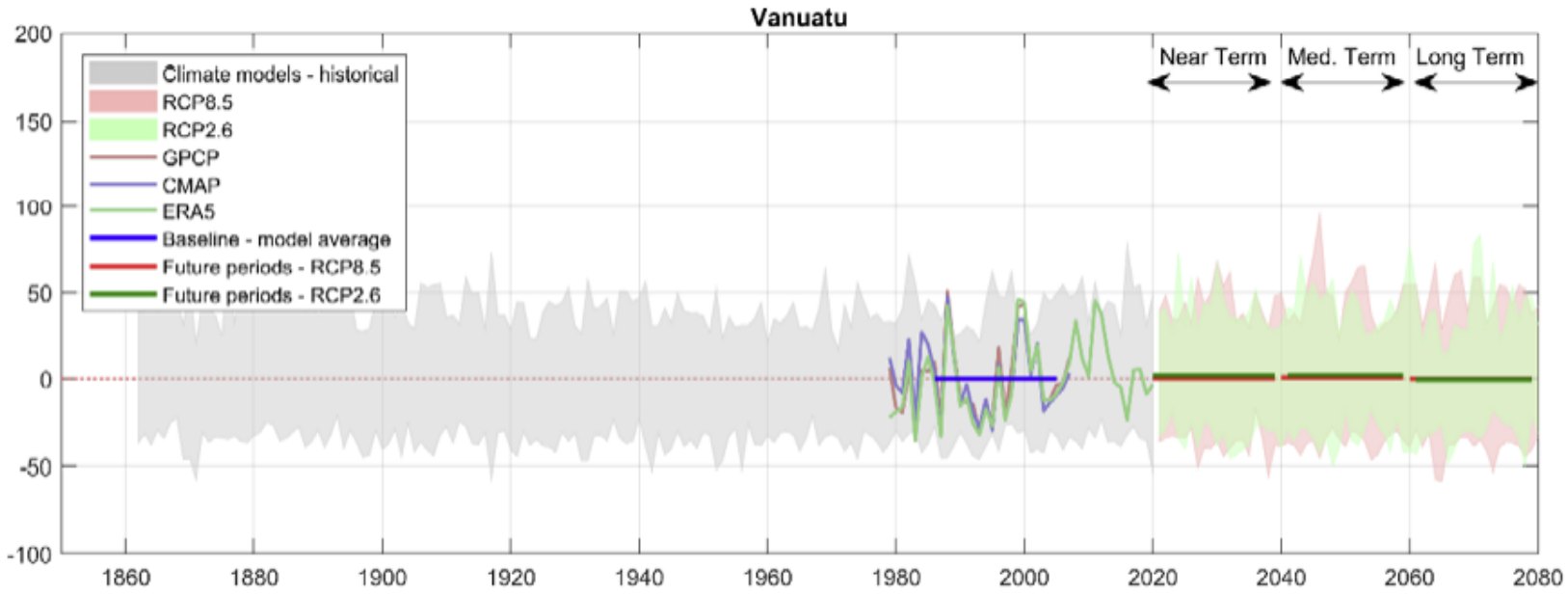
Historical and projected change in rainfall



Source: CSIRO & SPREP 2021, Figure 3.3

- Annual total rainfall shows large year-to-year variability, partly related to the El Niño Southern Oscillation, and weather station data show no significant trends since 1960 or 1850-1900
- In future, average annual rainfall shows little change, with large uncertainty
- By 2030, projected annual rainfall change is +1% (-9 to +13%) in all emission scenarios, relative to 1986-2005
- By 2070, the change is 0% (-9 to +10%) under low emissions (RCP2.6), and +2% (-16 to +15%) under high emissions (RCP8.5), relative to 1986-2005

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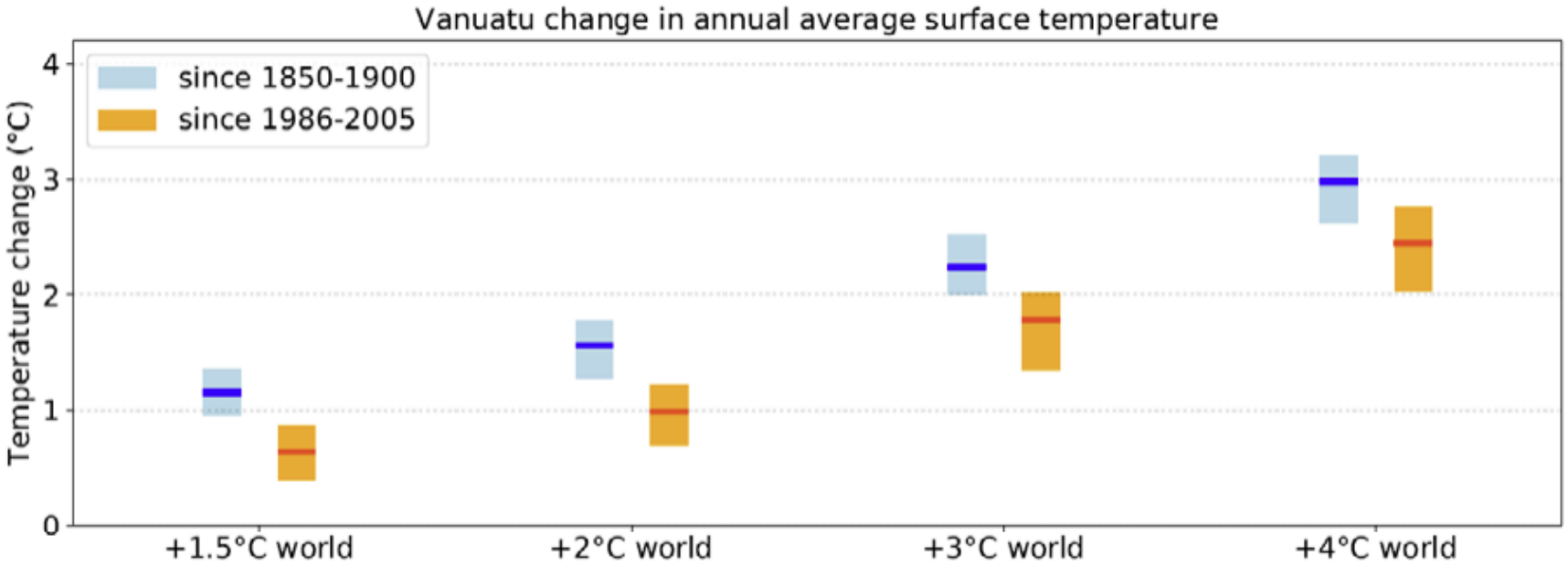
Regional projections for different levels of global warming



Source: CSIRO & SPREP 2021, Figure 4.5

The blue bars indicate that, relative to 1850-1900:

- in a 1.5°C warmer world, Vanuatu warms by 1.0 to 1.5°C
- in a 2°C warmer world, Vanuatu warms by 1.3 to 1.9°C
- in a 3°C warmer world, Vanuatu warms by 2.1 to 2.7°C
- in a 4°C warmer world, Vanuatu warms by 2.6 to 3.4°C

The orange bars show changes relative to 1986-2005

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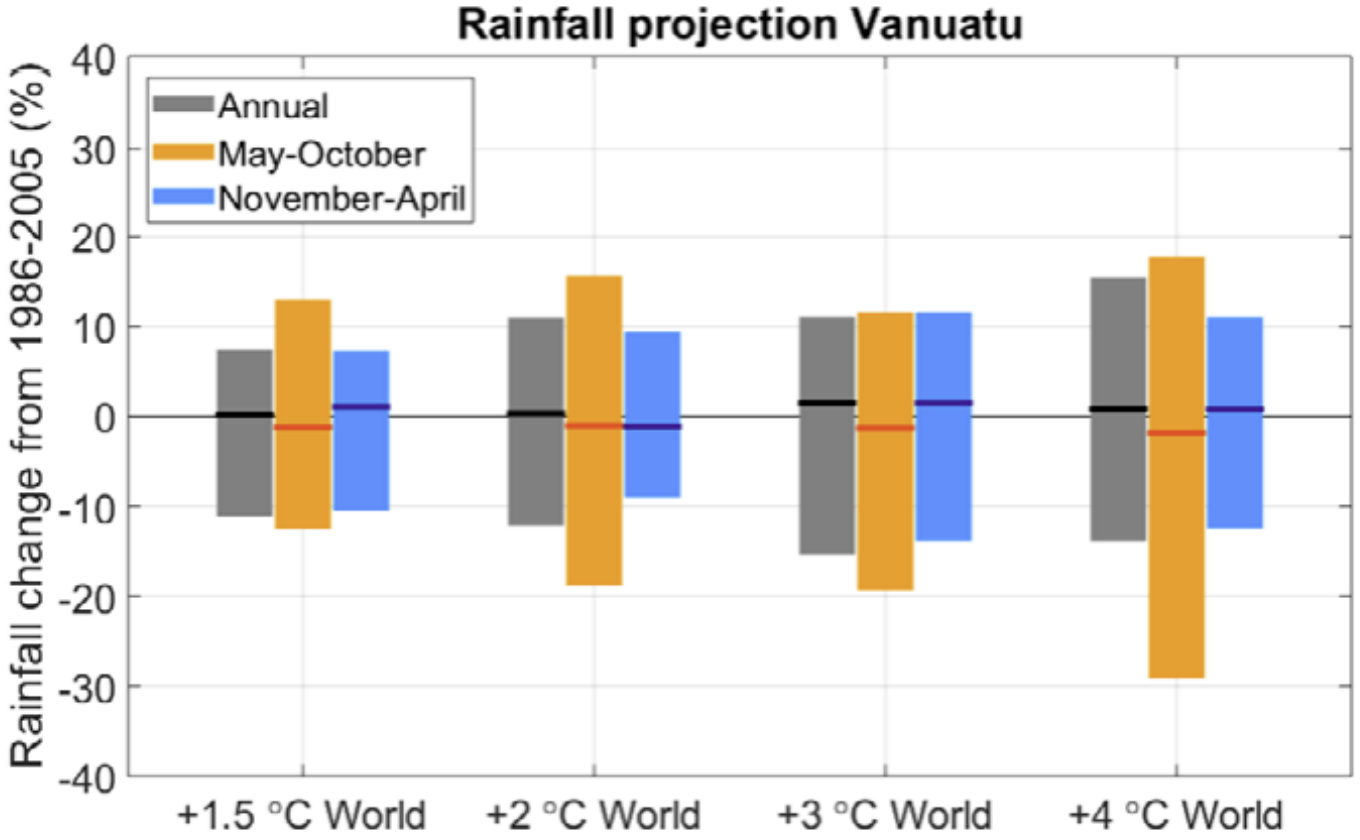
Regional projections for different levels of global warming



Source: CSIRO & SPREP 2021, Figure 4.6

The grey bars indicate that, relative to 1986-2005:

- in a 2°C warmer world, Vanuatu annual rainfall changes by 0% (-12 to +11%)
- in a 3°C warmer world, Vanuatu annual rainfall changes by +2% (-15 to +11%)

The orange bars show small decreases in May-October rainfall

The blue bars show small increases in November-April rainfall

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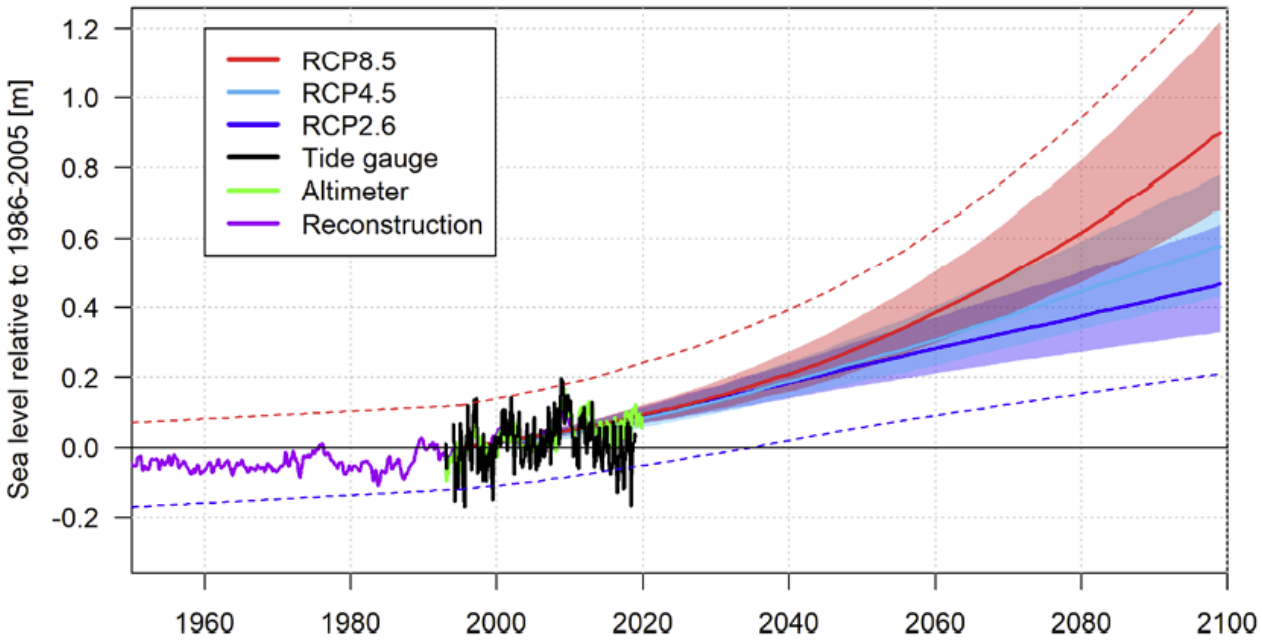
Sea level rise



	RCP 2.6		RCP 4.5		RCP 8.5	
Year	Sea level rise		Sea level rise		Sea level rise	
2030	0.13	[0.10-0.17]	0.13	[0.09-0.17]	0.14	[0.10-0.18]
2040	0.18	[0.14-0.23]	0.18	[0.14-0.24]	0.20	[0.15-0.26]
2050	0.23	[0.17-0.30]	0.24	[0.18-0.31]	0.28	[0.22-0.37]
2060	0.28	[0.21-0.37]	0.30	[0.23-0.40]	0.37	[0.29-0.49]
2070	0.32	[0.24-0.43]	0.37	[0.28-0.48]	0.48	[0.37-0.64]
2080	0.37	[0.27-0.50]	0.44	[0.33-0.58]	0.60	[0.46-0.81]
2090	0.42	[0.30-0.57]	0.51	[0.38-0.68]	0.74	[0.57-1.00]
2100	0.47	[0.33-0.64]	0.58	[0.43-0.78]	0.90	[0.68-1.22]

- Sea level rise of 9-18 cm is projected by 2030 for all emission scenarios, relative to 1986-2005
- By 2050, sea level rise of 17-30 cm is projected for low emissions (RCP2.6) and 22-37 cm for high emissions (RCP8.5)
- By 2100, sea level rise of 33-64 cm is projected for low emissions (RCP2.6) and 68-122 cm for high emissions (RCP8.5)

Source: CSIRO & SPREP 2021, Figure 5.2 and Table 5.1

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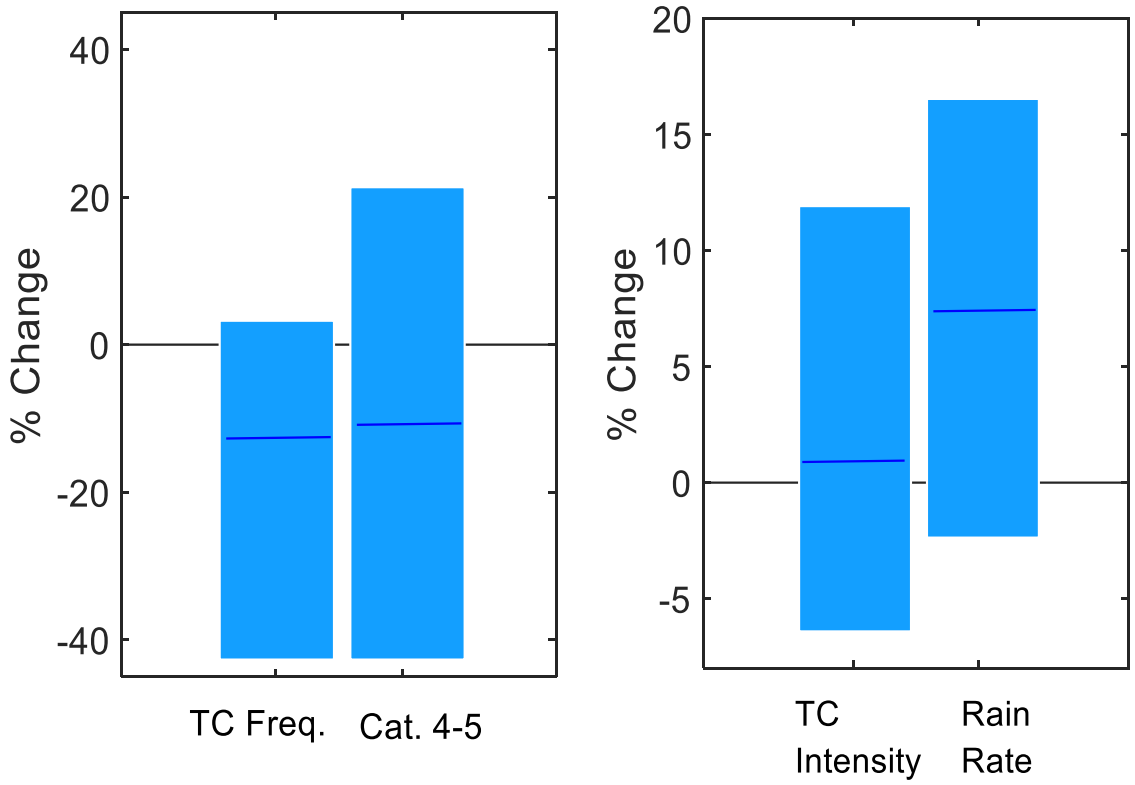
Tropical cyclones



Projected changes for Vanuatu in tropical cyclone (TC) frequency, severe TC (Cat 4-5) frequency, intensity (windspeed) and rainfall rate for a 2°C global warming

Source: CSIRO & SPREP 2021, Figure 5.1

- High confidence that cyclone frequency will decrease
- Low confidence for changes in the frequency of severe (category 4-5) cyclones
- Medium to high confidence for an increase in average cyclone intensity (windspeed)
- Medium to high confidence for an increase in cyclone rainfall rates
- High confidence that sea level rise will increase cyclone-related storm surge events
- Therefore, projected increase in average cyclone intensity, combined with sea level rise and increased rainfall rates, would increase cyclone impacts

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Standardised scenarios

	Scenario 1* SPCZ moves north	Scenario 2* SPCZ moves south
Low emissions (RCP2.6)	***Warmer & drier*** • Annual temperature: +0.5°C • Annual rainfall: -10% • More heatwaves • Less humidity • More solar radiation • Heavier rainfall events • Greater tropical cyclone impacts • Sea level rise: 17-30 cm	***Much warmer & wetter*** • Annual temperature: +1.0°C • Annual rainfall: +10% • More heatwaves • More humidity • Less solar radiation • Much heavier rainfall events • Greater tropical cyclone impacts • Sea level rise: 17-30 cm
High emissions (RCP8.5)	***Much warmer & drier*** • Annual temperature: +0.8°C • Annual rainfall: -10% • More heatwaves • Less humidity • More solar radiation • Heavier rainfall events • Greater tropical cyclone impacts • Sea level rise: 22-37 cm	***Hotter & much wetter*** • Annual temperature: +2.0°C • Annual rainfall: +20% • Many more heatwaves • More humidity • Less solar radiation • Much heavier rainfall events • Greater tropical cyclone impacts • Sea level rise: 22-37 cm

Source: CSIRO & SPREP 2021, Table 6.1

- A standardised climate scenario for 2050 provides a simple and useful way of understanding and quantifying climate change for Vanuatu in terms of the emissions pathways and climate responses
- Each scenario is internally consistent and physically plausible
- A physical storyline explains the difference between scenarios 1 and 2
- SPCZ is the South Pacific Convergence Zone (very wet)

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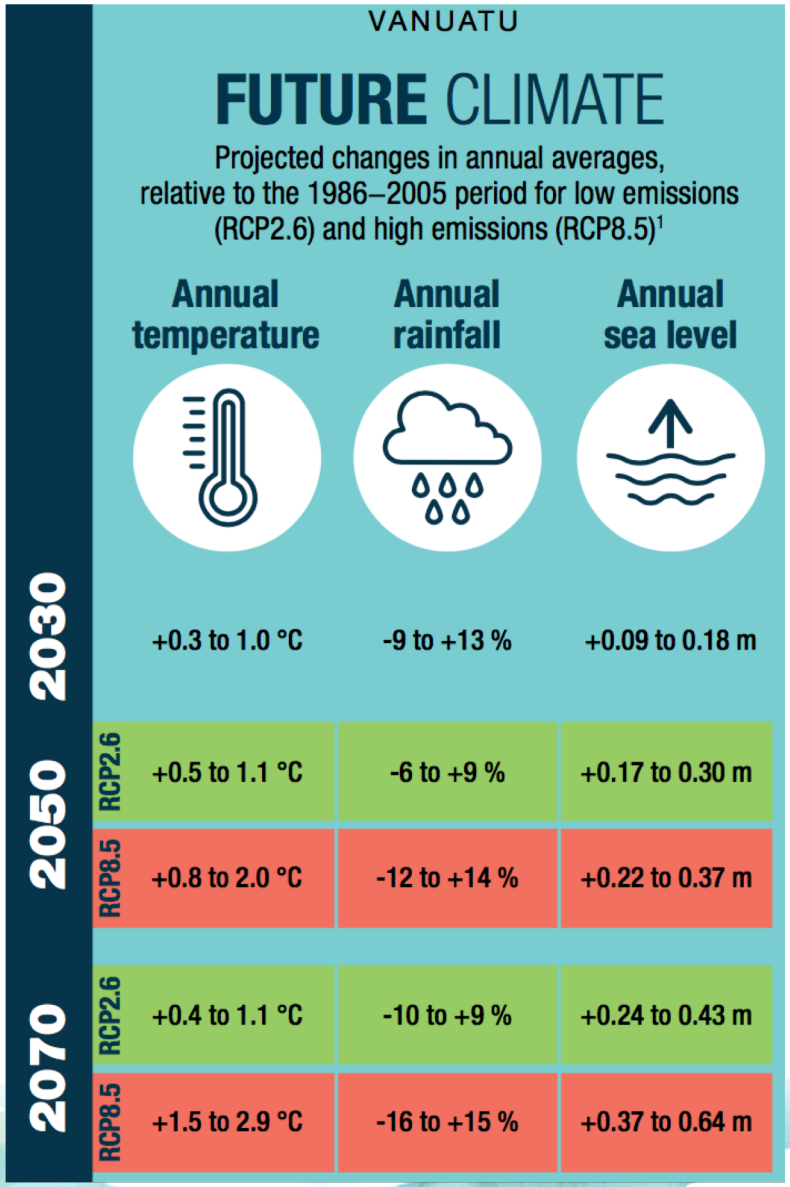
Key climate projections and hazard-based impacts



- Cyclone Pam in 2015 affected 188,000 people, displaced 65,000 people, and damaged 96% of crops and 81% of homes in affected areas
- Sea level rise will cause coastal inundation, erosion and saltwater intrusion into aquifers
- Coastal communities are highly exposed because 64% of the population of 234,000 live within 1 km of the coast
- Infrastructure within 500 m of the coast accounts for 48% of the total asset number and 90% of the total infrastructure replacement value
- Severe coral bleaching may occur on an annual basis by 2043 under RCP8.5
- Maximum fisheries catch potential is projected to decline 25% by 2090 under RCP8.5

Source: Pacific 'NextGen' Projections: Digital Digest

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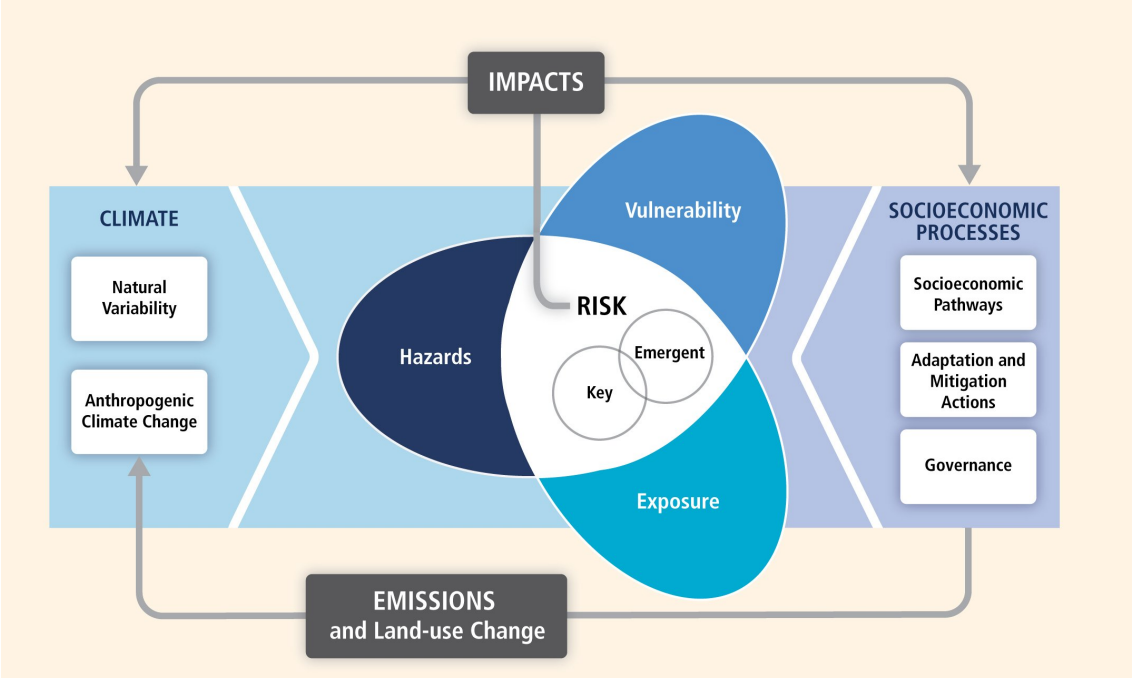
Managing climate hazard-based impacts and risks



Source: Intergovernmental Panel on Climate Change 2014, Figure 19-1

- Climate hazard-based impacts depend on the magnitude and rate of global warming
- Societal and ecosystem risks from these impacts depend on impact exposure and vulnerability, and the implementation of adaptation and mitigation actions (see opposite)
- Pathways to limit 1.5°C global warming involve a decline in global net carbon dioxide emissions by about 45% from 2010 levels by 2030, reaching net zero around 2050
- A wide range of adaptation options is available. These can reduce or at least better manage the risks of climate change, but there are practical limits to adaptive capacity for some human and natural systems
- Strengthened multi-level governance, institutional capacity, policy instruments, technological innovation and mobilisation of finance can enhance the feasibility of mitigation and adaptation

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Acknowledgements

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The project team would like to acknowledge the technical support of the Vanuatu Meteorology and Geohazards Department.

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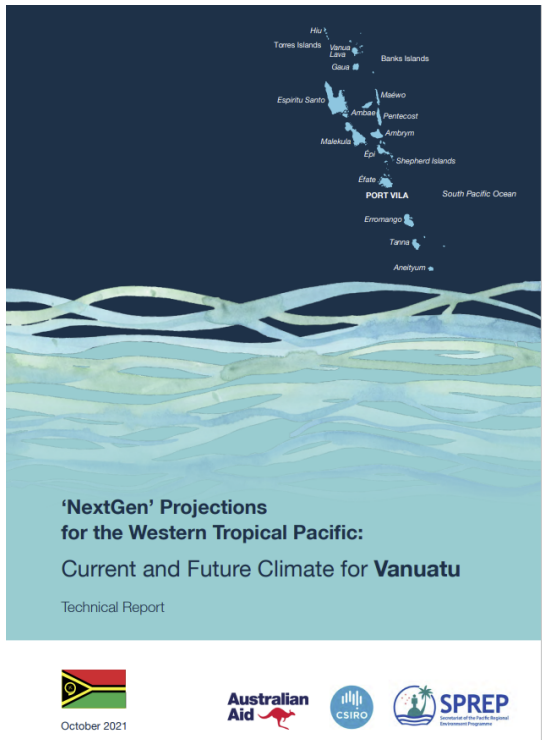
Click on the links to access the original reports and other related communication and knowledge brokering products:



CSIRO and SPREP (2021).
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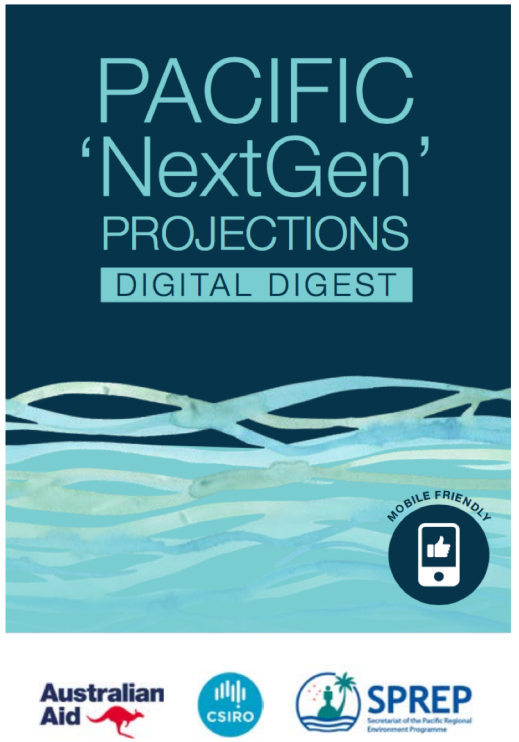

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