Pacific Climate Change Science

Regional Climate Science for the Pacific

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.....on behalf of PACCSAP Science Program (CSIRO & Bureau of Meteorology), incl. collaborative partners in Australia & the Pacific



Pacific-Australia Climate Change Science and Adaptation Planning Program

Australian Government

Presentation Outline

- Overview PACCSAP Science Program
- Overview new science, tools, communication & capacity development
- Decision-centred approach to adaptation
- Delivering climate science-based evidence
- Data and information management
- Post-PACCSAP future









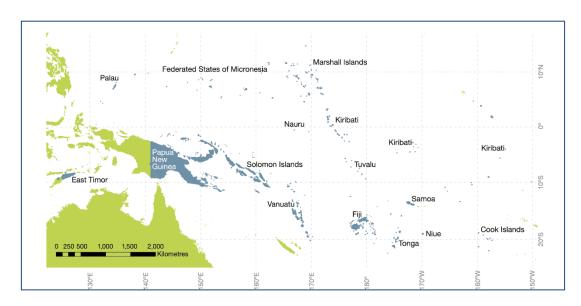
PCCSP/PACCSAP Science

- Pacific Climate Change Science Program (PCCSP)
 - − ~\$20m over ~ 2.5 yrs (2008/09-2010/11)
- Pacific Australia Climate Change Science & Adaptation Planning (PACCSAP) Science Program
 - − ~\$20m over ~ 2.5 yrs (2011/12-2013/14)
- Funded & administered by Australian Government:
 - Dept Foreign Affairs & Trade (DFAT) and Dept of Environment (DoE)
- Delivered by Centre for Australian Weather & Climate Research (CAWCR):
 - partnership between CSIRO and Bureau of Meteorology (BOM)
- 15 diverse partner countries & numerous regional organisations and universities incl. SPREP, SPC, USP, Red Cross and GIZ
- Other Australian agencies: Geoscience Australia, ARC Centre of Excellence for Climate System Science



PCCSP/PACCSAP Science

- Regional focus on 14 Pacific Island Countries (PICs) + Timor-Leste
 - key stakeholders National Met Services
- Response to considerable PIC needs (demand driven, next/end user focus)
- Data/information (knowledge), tools and capacity to facilitate decision-making & associated pathways to adaptation



PACCSAP Science – strategic drivers

- PACCSAP two components:
 - Adaptation Component (DoE)
 - Science Component (CSIRO & BOM)
- PACCSAP goal & objective:
 - PICs developed capacity to monitor & adapt to changing natural environment, & enhanced resilience to impacts of climate change
 - Emphasis on PIC scientists, decision-makers & planners to apply info/tools & develop in-country responses
- PACCSAP Science component objective:
 - Primary: Improve scientific understanding of climate change in the Pacific
 - Together with DoE:
 - Increased awareness of climate science, impacts and adaptation options
 - Better adaptation planning to build resilience to climate change impacts





PACCSAP Science Program - Scope

New science

- Seasonal predictions & climate data (data rescue, digitisation & management)
- Large-scale climate features & variability
- Regionally specific projections & extreme events
- Ocean processes

Tools development & technical support

- Pacific Climate Futures
- CliDE data management system
- Data portals

Communication products

- Technical Report
- Synthesis Report
- Journal papers, animations, fact sheets, training resources, website

Capacity development

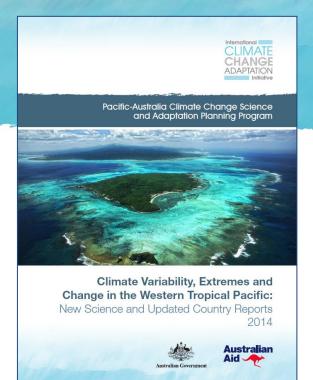
- Mentoring & attachments
- Technical training
- Workshops, conferences, symposia
- Networking & relationship management



New science/new products

- Climate variability, extremes and change in the western tropical Pacific: new science and updated country reports.....(BOM & CSIRO, 2014)
- Technical report, country specific chapters:
 - Climate summary
 - Data availability
 - Seasonal cycles
 - Observed trends
 - Climate projections (CMIP5)
- On-line publication

http://www.pacificclimatechangescience.org



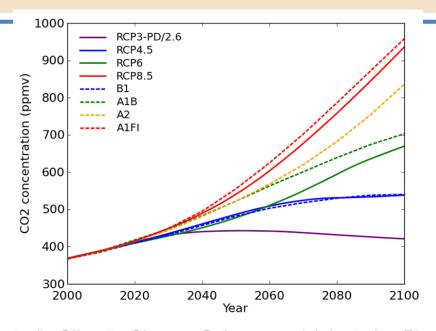




Global Context-IPCC AR5 WG1

E.1 Atmosphere: Temperature

Global surface temperature change for the end of the 21st century is *likely* to exceed 1.5°C relative to 1850 to 1900 for all RCP scenarios except RCP2.6. It is *likely* to exceed 2°C for RCP6.0 and RCP8.5, and *more likely than not* to exceed 2°C for RCP4.5. Warming will continue beyond 2100 under all RCP scenarios except RCP2.6. Warming will continue to exhibit interannual-to-decadal variability and will not be regionally uniform (see Figures SPM.7 and SPM.8). {11.3, 12.3, 12.4, 14.8}





New science/new products

- Climate Change in the Pacific: A Regional Summary of New Science and Management Tools (CSIRO, BoM & SPREP, in prep)
 - Plain language report:... "telling the story of the science"...
 - Targeted at non-technical audience in the Pacific, incl:
 - Sectoral policy makers, planners & associated decision-makers
 - National/sub-national to community level
 - Regional context but with PIC perspectives:
 - Understanding changing climate in the Pacific
 - About the science climate data, modelling, projections & RCPs, uncertainty, confidence, downscaling
 - Large-scale climate features
 - Temperature, rainfall, oceans, tropical cyclones
 - Climate science tools
 - On-line publication (http://www.pacificclimatechangescience.org

Tools, Communication and Outreach Products

Existing:

- Enhanced development of CliDE and data portals
- >35 peer reviewed journal papers incl. partner country co-authorships (+ PCCSP!!),
 IPCC AR5 (WG 1 & 2) reporting + misc. other reports and databases
- Animations:
 - Climate Crab regional
 - Cloud Nasara Vanuatu

New:

- Pacific Climate Futures V2.0 (n.b. PVUDP)
- Technical Report:
 - New Science & updated Country Reports

Pending:

- Summary Report (for policy makers; non-Technical)
- Training materials, Fact Sheets & new country brochures (non-Technical)





Data rescue & digitisation

Table 1 - Number of daily records key-entered during this project (to 31 May 2013)

		1		ı	
Type	Country	Stations	Work	Work	%
			Estimate	Done	Done
daily	Cook Islands	6	27466	7574	28
daily	Kiribati	5	57518	19898	35
daily	Niue	7	19710	4982	25
daily	PNG	158	400040	287454	72
daily	Solomon Islands	7	39777	31503	79
daily	Timor-Leste	15	342370	82711	24
daily	Tonga	6	30052	9720	32
daily	Vanuatu	8	25915	25915	100
daily	Samoa	64	294555	389961	132
subdaily	Niue	3	19710	6218	32
subdaily	PNG	5	400040	25490	6
subdaily	Solomon Islands	7	30660	41353	135
subdaily	Timor-Leste	6	342370	26026	8
subdaily	Tonga	5	11862	11862	100
subdaily	Vanuatu	8	25915	25915	100
subdaily	Samoa	52	294555	142954	49





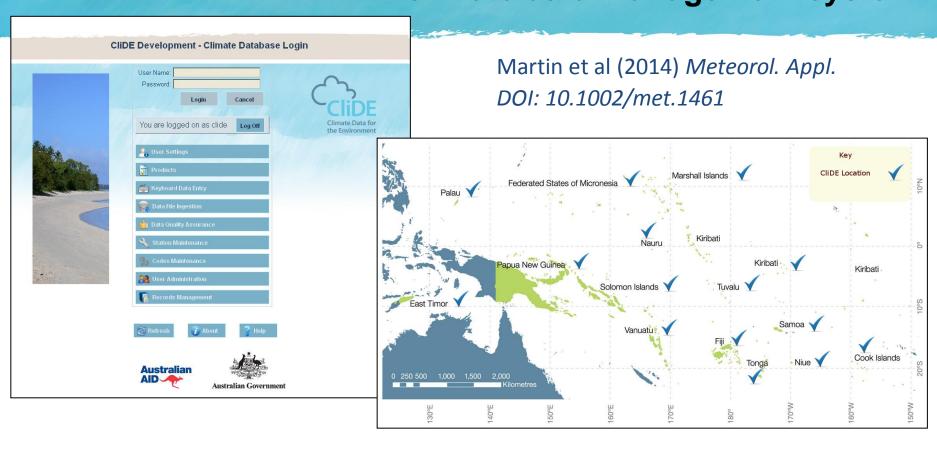
Table 2 - Partner PIC trainees in digitising data into CliDE in this project

Country	Male	Female	Total
Cook Islands	1	3	4
East Timor	2	4	6
Kiribati	2	4	6
Niue	1	4	5
PNG	2	4	6
Samoa	1	3	4
Solomon Islands	4	3	7
Tonga	2	4	6
Vanuatu	3	3	6
Total	18	32	50



Pacific-Australia Climate Change Science and Adaptation Planning Program

CliDE: Climate Data for the Environment - climate data management system



- CliDE is now installed and training provided to met services in 14 Pacific Island Countries plus East Timor
 - now used operationally for data storage and management
 - Visualisation/applications (CLEWS) through CliDEsc (NIWA).



Causes of climate change

The Earth's climate has changed over the centuries and millennia due to a number of different factors (see Figure 9).

These include:

- Natural changes in the Earth's orbit which may occur over time scales of thousands of years
- Natural changes in the sun which affect the amount of incoming solar radiation
- Natural, large-scale volcanic eruptions which eject large amounts of ash into the atmosphere. The ash may remain in the atmosphere for several months or years reflecting sunlight back into space and resulting in a drop of mean global surface temperature
- Changes in atmospheric chemistry (such as the quantity of greenhouse gases) both natural and caused by human activities. It
 is almost certain that most of the changes seen in the past century have been caused by human activities such as burning fossil
 fuels. We will now concentrate on these changes.

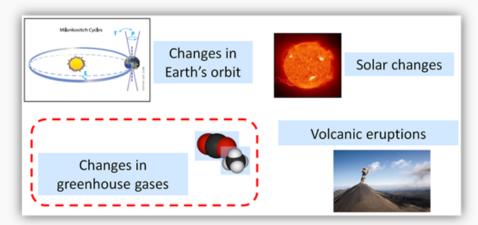


Figure 9: Factors that lead to changes in the Earth's climate.

Pacific Cli

Project

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Decrease

5. Wors

Based on worst case

Large Inc

Increase

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Projections Builder: Results

These results were produced using the Pacific Climate Futures Projections Builder, based on the settings selected by the user. It is important to retain a record of those settings.

Representative Models

To identify the representative models, all models were ranked using a multivariate statistical technique (Kokic et al., 2002) to identify the model that is the best fit to the settings selected by the user for the Best and Worst cases.

In addition, where possible, the tool identifies the maximum consensus climate future (i.e. the climate future projected by at least 33% of the models and which comprises at least 10% more models than any other).

Case	Representative Model	Consensus
Best Case	CMIP3 - miroc3_2_hires	Very Low
Worst Case	CMIP3 - gfdl_cm2_1	Low
Maximum Consensus	CMIP3 - gfdl_cm2_0	Moderate

Table 1: Climate Futures description, consensus rating and representative model for each of the three cases: Best, Worst and Maximum Consensus.

	SURFACE TEMPERATURE	RAINFALL
	ANNUAL	ANNUAL
Best Case	3.23°C	-5.7%
Worst Case	2.46°C	31.3%
Maximum Consensus	2.46°C	2.1%

Table 2: Projected changes for each of the selected variables and seasons for the three cases described in Table 1.

USING THESE PROJECTIONS

In applying these projections to an impact assessment, the results for each case should be used separately, resulting in separate statements of impact for each case.

Important: The projected changes shown in Table 2 are the results from the corresponding climate model as described in Tables 1 and 2. They represent the projected 20-year average change, calculated over the region selected and are calculated relative to the historic reference period 1986 to 2005. The projected changes are influenced concurrently by the long-term climate trend and the decade variability as simulated by the relevant climate model.

Use of these results is subject to the Pacific Climate Futures Terms of Use, as updated from time-to-time, which can be viewed at the website http://pacificclimatefutures.net.

A detailed description of the Climate Futures method can be found in Whetton et al. 2012. The use of the method in an impact assessment is described in detail in Clarke et al. 2011.

REFERENCES

Clarke JM, Whetton PH, Hennessy KJ (2011) 'Providing Application-specific Climate Projections Datasets: CSIRO's Climate Futures Framework.' Peer-reviewed conference paper. In F Chan, D Marinova and RS Anderssen (eds.) MODSIM2011, 19th International Congress on Modelling and Simulation. Perth, Western Australia. December 2011 pp. 2683-2690. ISBN: 2978-2680-9872143-9872141-9872147. (Modelling and Simulation Society of Australia and New Zealand). http://www.mssanz.org.au/modsim2011/F5/clarke.pdf.

Kokic P, Breckling J, Lübke O (2002) 'A new definition of multivariate M-quantiles.' in Statistical Data Analysis Based on the L1-Norm and Related Methods. (Y Dodge ed.) pp. 15-24. (Birkhäuser Verlag: Basel).

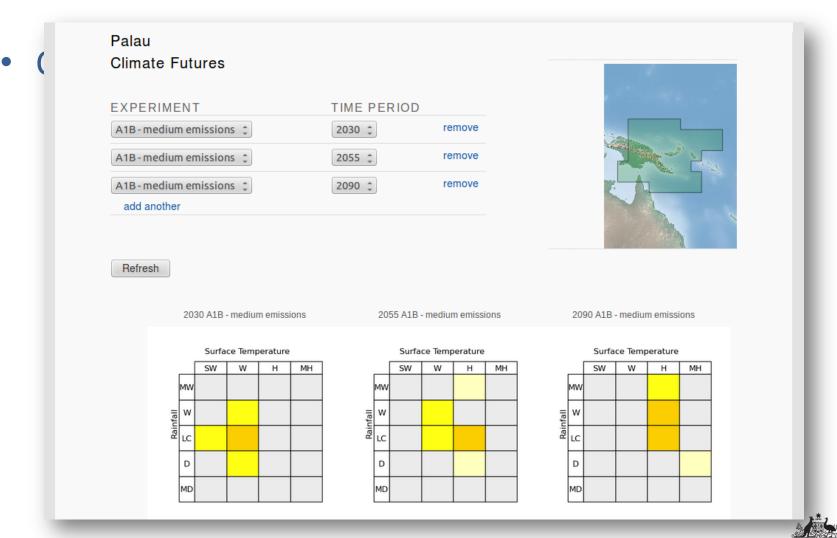
Whetton P, Hennessy K, Clarke J, McInnes K, Kent D (2012) 'Use of Representative Climate Futures in impact and adaptation assessment.' Climatic Change 115, 433-442. 10.1007/s10584-012-0471-z.

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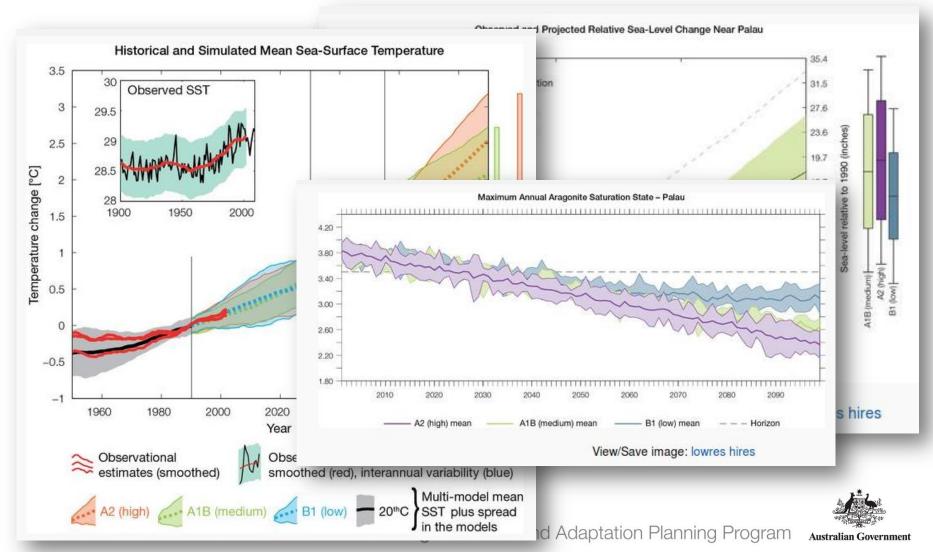


Pacific Climate Futures V2.0



Pacific Climate Futures V2.0

Marine Projections



New products – Pacific Climate Futures V2.0

What's new:

- CMIP5 Data
- Downscaled data for all countries (50km resolution)
- Online training: access to Projections Builder (Intermediate capability)
- Projections Builder: guided generation of internally consistent projections data (Best, Worst and Max. Consensus cases) tailored to suit non-complex impact assessments
- Compare Projection module: contextualise results from multiple sources (e.g. Downscaling, CMIP3, CMIP5); display changes over time
- Online access to pre-calculated, high quality sea level, SST and ocean acidification data
- Outputs applied to observed data sets (CliDE/portal) to generate application-ready climate change data (Advanced capability)

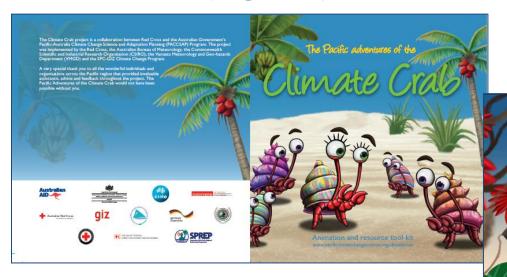


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Climate animations

• Climate Crab (regional) & Klaod Nasara



Resource kits

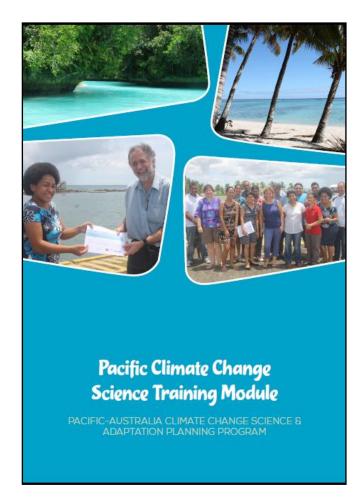


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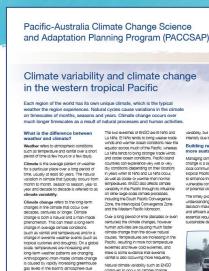
New science/new products

- Climate science-based training module & associated materials, including documented 'manual' & ppt presentations:
 - Country specific presentations (14 x PICs + Timor-Leste)
 - Tailored for NMSs
 - Regional Pacific current/future climate
 - Understanding climate projections
 - Understanding climate variability and change
 - Tailored for more general use
 - ppt presentation templates to facilitate 'small group' discussions
 - Tailored for more general use





Fact Sheets



oil and natural gas). Natural climate change is usually much slower and driven by changes in the sun or volcanic eruptions. How do climate variability and climate change relate?

ostly to burning fossil fuels (such as coal

The annual cycle of wet and dry seasons is one example of natural ofmate variability experienced by every island in the estern tropical Pacific. This cycle varies in timing and intensity between years.

The most dramatic cause of climate

The two extremes of ENSO are El Niño and La Niña. El Niño tendis to bring weaker trade winds and warmer opean conditions near the **Building resil** more sustain La Niña tends to bring stronger trade winds and cooler ocean conditions. Pacific island countries can experience very wet or very change is a signifi dry conditions (depending on their location) in years when El Niño and La Niña occur. tropical Pacific, Ar termoratures. ENSO also affects climate variability in the Pacific through its influence on other large-scale climate processes, including the South Pacific Convergence including the South Pacific Convergence The Influence The Infl understanding and decision-making v Zone, the Intertropical Convergence Zone

to enhance the r

The timely prov

and efficient add

Over a long period of time (decades or even centuries) the climate changes, however human activities are causing much faster olimate change than the slower natural causes. Temperatures are increasing in the Pacific, resulting in more hot temperature extremes and fewer cold extremes, and there is some evidence that extreme rainfall is also occurring more frequently Not yal almate variability buch as ENSO continues to occur as climate change slowly increases. This means that droughts and floods due to El Niño and

La Niña still occur due to natural climat



Pacific-Australia Climate Change Science and Adaptation Planning Program (PACC

Climate extremes in the western

Countries in the western tropical Pacific are particularly vulnerable to impacts from extremes in temperature, rainfall and sea-level rise as well as tropical cyclones

What are climate extremes? Climate extremes are short-term weather or longer-term climatic events that are rare or uncommon in occurrence, and often excessively severe in impact. Extreme events resulting from natural

ariability in large-scale climate processes from season to season and year to year, can cause massive loss and damage to infrastructure, industry and environmenta assets, and can impact on the health, safet, and overall wellbeing of local communities These large-scale processes include the I Nino Southern Oscillation (ENSO), the South Pacific Convergence Zone (SPCZ), the West Pacific Monsoon (WPM) and the Intertropical Convergence Zone (ITCZ). Longer-term variability and climate change compound these impacts, particularly in terms of increased vulnerability to

What has happened in the past? Temperature: There have been more frequent hot days and warm nights and fewer cool days and cool nights, as average air temperatures have increased significantly over the last 50 years.

natural, climate-related disasters.

Rainfall: Rainfall extremes are primarily influenced by year-to-year and decade-to decade variability associated with ENSO and the intensity/location of other major olimate features such as the SPCZ, ITCZ and WPM. As an example, La Niña events in recent years have been associated with severe drought in Tuvalu and floods in Fiji.

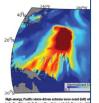
Tropical cyclones: On average, nine tropical cyclones occur in the western Pacific region between November and April each year, mostly between January and March. The greatest numbers of donia region. The frequency and from year to year, largely due to ENSO

to tides, weather and climate variability can be quite large at any one time scale, primarily due to thermal expansio of water as the oceans warm, and melting of glaciers, ice caps and ice sheets on

in the future?

Temperature: Scientists are very confident that the intensity and free ieno. that are considered a heat wave in the current climate are projected to become longer, but the exact range of extreme heat temperatures is still uncertain.

Rainfall: Almost all Pacific island countrie are projected to get more rainfall and fewer droughts, with some showing little change. Longer-term projections of extreme rainfall days differ for each



Pacific-Australia Climate Change Science and Adaptation Planning Program (PACCSAP)

aragonite) is hard reef stru

Ocean acidification in t

the Pacific in response to increasing carbon dioxide in the atmosphere entering the ocean poses a significant threat to long-term viability of coral reefs and associated communities that rely on them for their livelihood and wellbeing What is ocean acidification?

Ocean acidification is a change in ocean chemistry that occurs when atmospheric carbon dioxide is taken up by the ocean thereby increasing pH. Carbon dioxide is a weak acid, so when it enters the ocean it reacts with seawater, increasing acidity. Oceans absorb about 25% of the carbon dioxide that is emitted into the atmosphere annually. As more carbon dioxide enters the atmosphere more carbon dinvide is lolved in the oceans. This process a key role in reducing the rate of global

high and me suggest it w but it also changes the chemistry of the oceans. Carbonate (ion) is one form in which carbon is stored in the ocean, and which carbon is stored in the obein; and is a critical requirement for coral growth. Increased acidity will recut in less carbonate (cn) availability in the obsan to support coral growth. This poses a significant only stop an threat to the diversity, productivity and overall health of vulnerable, high-value · As corals be aquatic ecosystems, including coral reef



Pacific-Australia Climate Change Science and Adaptation Planning Program (PACCSAP)

Large-scale climate features in the western tropic

The Pacific Ocean covers at presence of large-scale clima leads to profound year-to-year small island nations dotted th

drive the climate of the western tropical Pacific?

The major large-scale climate feature Pacific Convergence Zone (SPCZ), the Intertropical Convergence Zone (TCZ) and the West Pacific Monsoon (WPM) (Fig. 1). These features affect the region pattern and seasonal cycle in rainfall, v tropical cyclone tracks, ocean currents nutrients and many other aspects of ti olimate and the environment in gener

El Niño Southern Oscillation The El Niño Southern Oscillation is the major influence on climate variability in

and coral bi the western tropical Pacific. It particu more vulner affects the year-to-year risk of drought extreme rainfall and floods, tropical oy and stormextreme sea levels and coral bleaching During normal conditions, when ENSC in its 'neutral' phase, the equatorial to warming oce may occur at



Figure 1: Average positions of the SPC features in the western tropical Pacific, winds; blue shading, bands of rainfall; r red H, typical position of moving high p

Pacific-Australia Climate Change Science and Adaptation Planning Program (PACCSAP)

Sea-level rise in the western tropical Pacific

as well as climate change. A small amount of overall, long-term sea level rise due to climate change will compound the effects of natural

variability and cause extreme sea levels to happen more often. What factors affect sea level?

Sea levels change daily, monthly and annually due to a combination of tides

by the gravitational pull of the sun and

storm tide level

of any year, unusually large (king') tides can occur, but all tides are natural and that may be up to several metres or more at a particular time and place. Climate variability due to seasonal change

generally periodic and predictable events

to overall changes in trade wind patterns and surge caused by tropical cyclones temperature, which in turn may affect sea. level at timescales of months to years. For instance, ENSO can cause sea-level chang up to 30 cm in the western tropical Pacific, depending on time of year and location.

Occasionally, tides, weather and climate variability combine to cause sealevel extremes, resulting in flooding, erosion and other serious impacts to

Climate change and sea-level rise Climate change causes changes in sea

causing an increase in sea levels. This thermal expansion is very small but the average depth of most oceans is 3500 m, meaning that even a little expansion has an important influence on sea-level rise.

(2) Over the past century, warmer ice sheets on land to melt at an accelerating rate. This increased run-off to the sea has contributed to

natural sea-level changes due to tides. weather and climate variability can be quite large at any one time compared to sea-level rise through climate change alone. A small amount of overall, long-

Fact Sheets (http://www.pacificclimatechangescience.org):

- Climate variability & change
- Large-scale climate processes
- Climate extremes
- Sea-level rise
- Ocean acidification

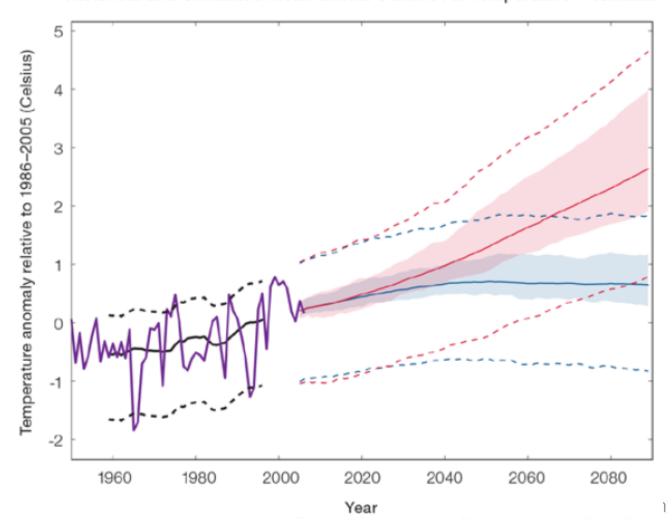




Vanuatu: Temperature Projections



Historical and Simulated Mean annual Surface Air Temperature - Vanuatu

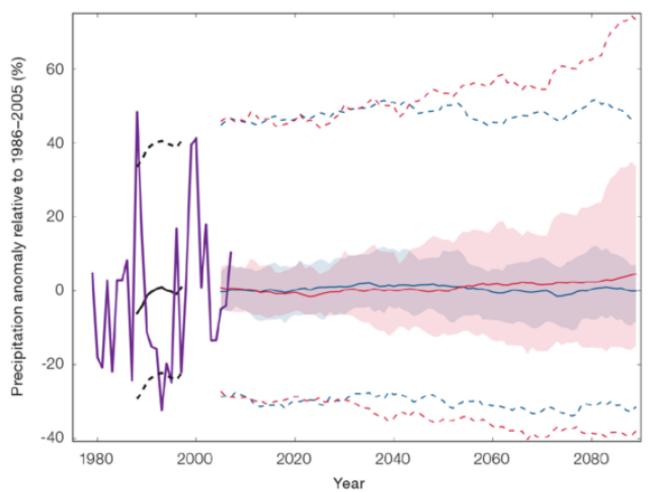




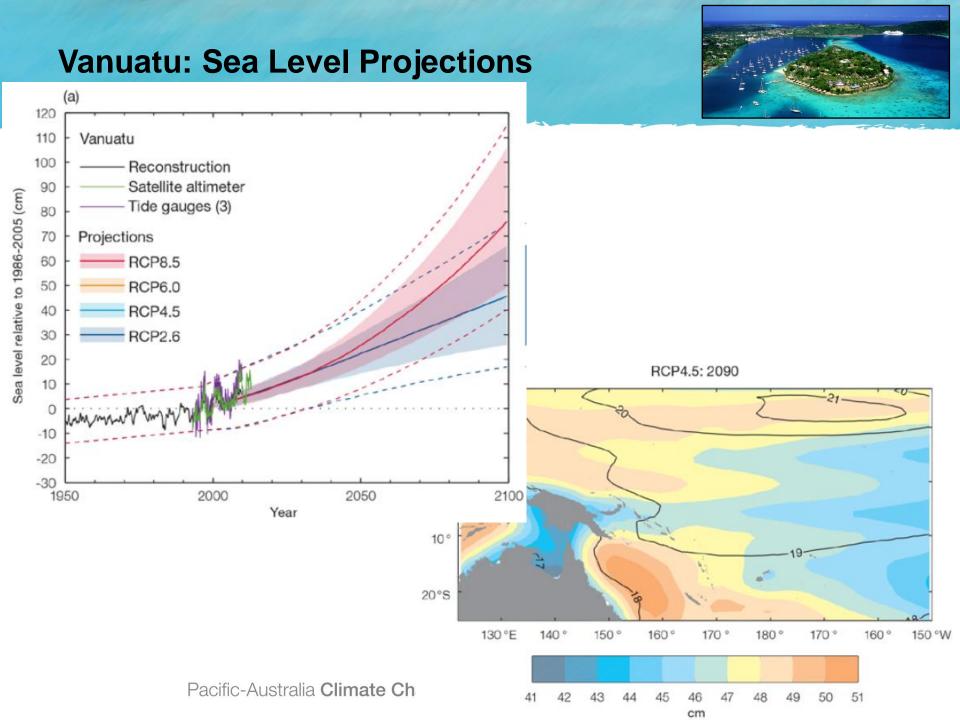
Vanuatu: Rainfall Projections



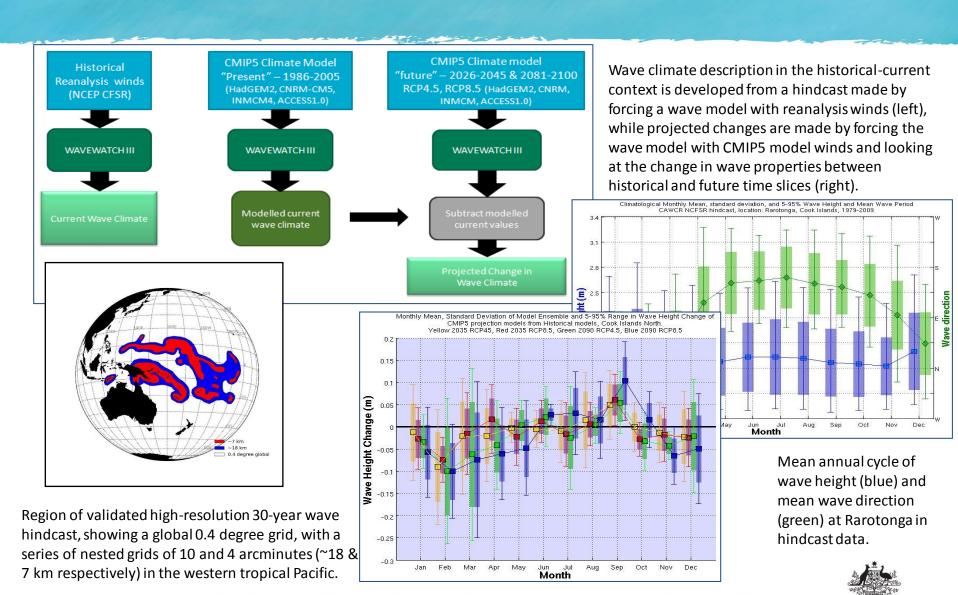
Historical and Simulated Mean annual Precipitation - Vanuatu







Technical Report – observed & projected wave climate

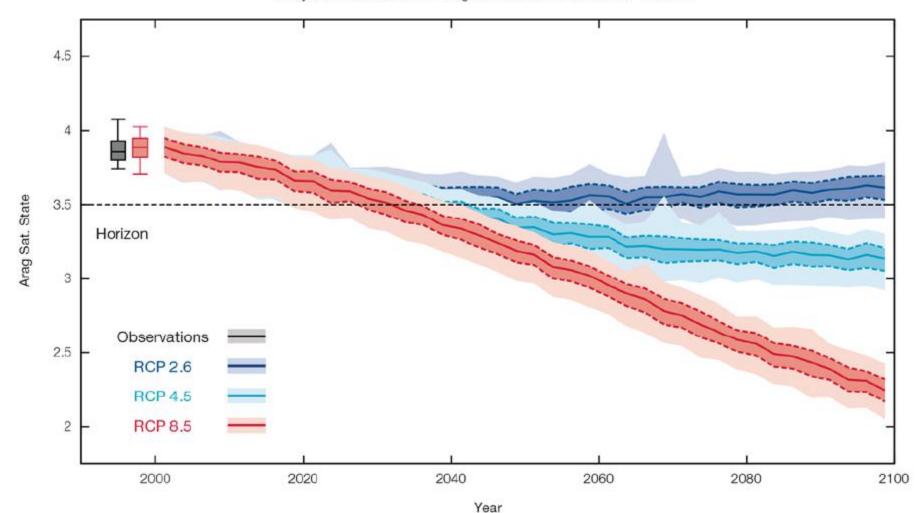


Australian Government

Vanuatu: Marine Projections







Vanuatu: Marine Projections



Projected decreases in aragonite saturation state for Vanuatu

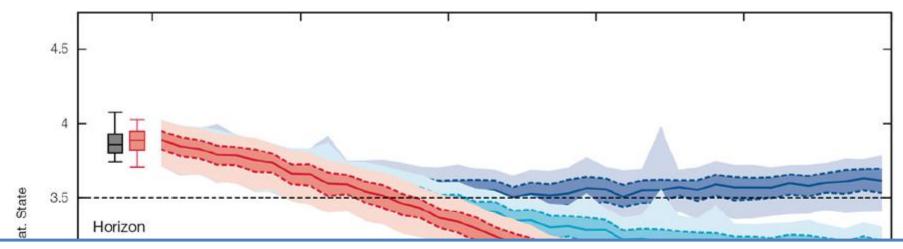


Table 16.5: Projected changes in severe coral bleaching risk for the Vanuatu EEZ for increases in SST relative to 1982–1999.

Temperature change ¹	Recurrence interval ²	Duration of the risk event ³
Change in observed mean	30 years	4.1 weeks
+0.25°C	26.1 years (24.8 years - 27.4 years)	5.6 weeks (5.1 weeks - 6.0 weeks)
+0.5°C	20.3 years (15.8 years - 24.4 years)	5.3 weeks (4.2 weeks - 6.5 weeks)
+0.75°C	9.5 years (3.2 years - 18.0 years)	6.9 weeks (3.3 weeks - 2.3 months)
+1°C	3.1 years (7.4 months - 8.7 years)	8.0 weeks (2.2 weeks - 3.5 months)
+1.5°C	11.8 months (4.9 months - 3.2 years)	3.1 months (2.8 weeks - 5.3 months)
+2°C	8.0 months (5.0 months – 1.6 years)	4.8 months (1.7 months – 6.5 months)

Vanuatu: Projections Summary



Variable	Season	2030	2050	2070	2090	Confidence (magnitude of change)
Surface air temperature (°C)	Annual	0.6 (0.4-0.9)	0.7 (0.5-1.1)	0.7 (0.4-1.1)	0.7 (0.3-1.2)	Medium
		0.6 (0.3-1)	0.9 (0.6-1.5)	1.2 (0.7-1.8)	1.3 (0.8-2)	
		0.6 (0.4-1)	0.9 (0.6-1.3)	1.2 (1-1.9)	1.6 (1.2-2.5)	
		0.7 (0.5-1)	1.3 (0.8-2)	2 (1.5-2.9)	2.7 (1.9-4)	
Maximum	1-in-20 year	0.6 (0.4-0.9)	0.7 (0.2-0.9)	0.7 (0.3-1)	0.7 (0.3-0.9)	Medium
temperature (°C)	event	0.6 (0.2-0.9)	0.9 (0.5-1.2)	1.2 (0.6-1.6)	1.3 (0.7-2)	
		NA (NA-NA)	NA (NA-NA)	NA (NA-NA)	NA (NA-NA)	
		0.7 (0.3-1.1)	1.4 (0.7-2)	2.1 (1.4-3.1)	2.9 (1.9-4.2)	
Minimum	1-in-20 year	0.5 (0.2-0.9)	0.6 (0.2-1)	0.7 (0.1-1)	0.6 (0.1-0.9)	Medium
temperature (°C)	event	0.6 (0.1-0.8)	1 (0.3-1.2)	1.1 (0.5-1.6)	1.3 (0.7-1.8)	
		NA (NA-NA)	NA (NA-NA)	NA (NA-NA)	NA (NA-NA)	
		0.8 (0.3-1)	1.4 (0.9-1.8)	2.2 (1.6-2.7)	3 (2.1-3.9)	1
Total rainfall (%)	Annual	1 (-7-9)	1 (-6-9)	0 (-10-9)	0 (-8-7)	Low
		0 (-9-13)	0 (-9-6)	1 (-9-9)	0 (-14-10)	
		2 (-4-13)	2 (-8-12)	3 (-6-16)	4 (-11-19)	
		0 (-6-8)	0 (-12-14)	2 (-16-15)	5 (-15-34)	
Total rainfall (%)	Nov-Apr	2 (-5-13)	2 (-6-9)	0 (-9-14)	1 (-7-13)	Low
		0 (-8-15)	1 (-9-9)	2 (-8-18)	1 (-13-13)	
		3 (-5-15)	2 (-7-11)	3 (-5-16)	3 (-11-22)	
		1 (-6-12)	1 (-9-13)	3 (-14-17)	5 (-13-30)	
Total rainfall (%)	May-Oct	0 (-11-12)	1 (-8-13)	-1 (-17-9)	-2 (-15-10)	Low
		0 (-12-15)	-1 (-13-11)	-2 (-14-12)	-1 (-25-14)	
		2 (-6-13)	2 (-11-16)	2 (-11-18)	5 (-9-21)	
		-2 (-10-8)	-1 (-19-16)	-1 (-21-17)	3 (-26-34)	
Aragonite saturation	Annual	-0.3 (-0.7-0.0)	-0.4 (-0.70.1)	-0.4 (-0.7-0.0)	-0.3 (-0.7-0.0)	Medium
state (Ωar)		-0.4 (-0.7-0.0)	-0.6 (-0.90.3)	-0.7 (-1.00.4)	-0.8 (-1.10.5)	
		NA (NA-NA)	NA (NA-NA)	NA (NA-NA)	NA (NA-NA)	
		-0.4 (-0.70.1)	-0.8 (-1.10.5)	-1.2 (-1.40.9)	-1.5 (-1.81.3)	
Mean sea level (cm)	Annual	13 (8-19)	23 (15-31)	32 (20-45)	42 (25-59)	Medium
		13 (8-18)	23 (15-32)	36 (23-49)	48 (30-67)	
		13 (8-18)	23 (15-31)	35 (23-48)	50 (32-69)	
		13 (8-18)	26 (17-35)	43 (29-59)	64 (42-89)	



Post-PACCSAP future



- PACCSAP Science Program finishes in 2014
 - New strategic benchmark in fundamental climate science for the western tropical Pacific (n.b. alignment with IPCC AR5)
 - Evaluation & final reporting: leverage off new knowledge, capacity & key learnings on

regional/inter-regional basis

- Strategic considerations:
 - Manage/action existing knowle sustainable legacy!!
 - Plan for sustainable resilient de
 - Role of climate science/outrea
 - GFCS innovation pathwa
 - Support in-country capacity d
 - Coordination, collaborat
 - What are the new and emerging

Framework is based around five components (or pillars) identified as being necessary for producing and delivering effective climate services:

USERS

USERS

Climate Service Information System

Observations and monitoring Research, Modelling and Prediction

CAPACITY

DEVELOPMENT

• tailored/application-ready, multiple sectors, multiple risks, multiple time-mame, niner spatial scale, seamlessly interfaced to DSS!!??

Thank you

For further information

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