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

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 decisionmaking & 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
 Pacific-Australia Climate Change Science and Adaptation Planning Program



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



New science/new products



Pacific-Australia Climate Change Science and Adaptation Planning Program

- 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



Climate Variability, Extremes and Change in the Western Tropical Pacific: New Science and Updated Country Reports 2014



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Executive Summary1
About this Report
Climate Modelling and Performance
About the Projections
What the Climate Observations, Trends and Projections Show4
Chapter 1: Introduction to the Country Reports
1.1 Climate Summary
1.2 Data Availability
1.3 Seasonal Cycles
1.4 Observed Trends
1.5 Projections
Chapter 2: Cook Islands21
2.1 Climate Summary
2.2 Data Availability
2.3 Seasonal Cycles
2.4 Observed Trends
2.5 Climate Projections



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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 (<u>http://www.pacificclimatechangescience.org</u>)



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)





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Data rescue & digitisation

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

Туре	Country	Stations	Work	Work	%
			Estimate	Done	Done
daily	daily Cook Islands		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





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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).



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Pacific Climate Futures V2.0

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:

Australian

- · 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

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

Case

Best Case

Worst Case

Maximum Consensus

USING THESE PROJECTIONS

as simulated by the relevant climate model.

of impact for each case.

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.

Representative Model

CMIP3 - miroc3 2 hires

CMIP3 - gfdl_cm2_1

CMIP3 - gfdl cm2 0

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

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

BAINFALL

In addition, where possible, the tool identifies the maximum consensus climate future (i.e. the climate future projected by at least 33% of the

Consensus

Very Low

Moderate

Low

Project

This sectic studying. For examp

increases

4. Best

Based on best (or le

Small Inc

Consensus. SURFACE TEMPERATURE

models and which comprises at least 10% more models than any other).

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

Decrease

5. Wors

Based on worst case

Large Inc

Increase

3.

То

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.

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

Important: The projected changes shown in Table 2 are the results from the corresponding climate model as described in Tables 1 and 2.

reference period 1986 to 2005. The projected changes are influenced concurrently by the long-term climate trend and the decade variability

They represent the projected 20-year average change, calculated over the region selected and are calculated relative to the historic

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.



Pacific Climate Futures V2.0

Palau Climate Futures

EXPERIMENT	TIME PERIOD)
A1B - medium emissions 💲	2030 ‡	remove
A1B - medium emissions 💲	2055 💲	remove
A1B - medium emissions 💲	2090 ‡	remove
add another		



Refresh



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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)



<u>www.pacificclimatechangescience.org</u> <u>www.pacificclimatefutures.net</u>



Climate animations

• Climate Crab (regional) & Klaod Nasara



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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



Pacific Climate Change Science Training Module

PACIFIC-AUSTRALIA CLIMATE CHANGE SCIENCE & ADAPTATION PLANNING PROGRAM



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Fact Sheets

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

Climate variability and climate change in the western tropical Pacific

Each region of the world has its own unique climate, which is the typical weather the region experiences. Natural cycles cause variations in the climate on timescales of months, seasons and years. Climate change occurs over nuch longer timescales as a result of natural processes and human activities

What is the difference between weather and climate?

ather refers to atmospheric co such as temperature and rainfall over a short period of time (a few hours or a few days). Climate is the average pattern of weather for a particular place over a long period of time, usually at least 30 years. The natural variation in ofimate that typically occurs from month to month, season to season, year to year and decade to decade is referred to as climate variability Climate change refers to the long-term

hanges in the climate that occur over changes in the cirmate that occur over decades, centurise or longer. Cirmate change is both a natural and a man-made phenomenon. This can mean a long-term change in average cirmate conditions (such as rainfall and temperature) and/or a change in extreme weather events (such as ropical cyclones and droughts). On a global cale, temperatures are increasing and ong-term weather patterns are changing. is caused by rapidly increasing greenhous gas levels in the Earth's atmosphere due ostly to burning fossil fuels (such as coal 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?

The annual cycle of wet and dry seasons is one example of natural climate variability experienced by every island in the estern tropical Pacific. This cycle varies in timing and intensity between years. Much of year-to-year climate variability is caused by natural variations in the conditions of the atmosphere and oce The most dramatic cause of climate

variability in the western tropical Pacific is the El Niño Southern Oscillation (ENSO).

Climate extremes

Ocean acidification

Sea-level rise

The two extremes of ENSO are El Niño and La N/ha. El N/ho tendis to bring weaker trade winds and warmer opean conditions near the equator across much of the Pacific La Niña tends to bring stronger trade winds and cooler ocean conditions. Paofic island countries can experience very wet or very dry conditions (depending on their location in years when El Niño and La Niña occur. as well as cooler or warmer than normal the war access ENSO also affects climate variability in the Pacific through its infuence on other large-scale climate processes, including the South Pacific Convergence Zone, the Intertropical Convergence Zone and the Western Pacific Monsoon Over a long period of time (decades or even centuries) the climate changes, however human activities are causing much faster climate 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



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Building resil

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and fewer cool days and cool rights, as average air temperatures have increased significantly over the last 50 years. 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 climate 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 Fili

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

occur in the Vanuatu-Nev

donia region. The frequency and

intensity of cyclones varies significan

from year to year, largely due to ENSO



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Climate extremes in the western

Sea level: Natural sea level changes due

red to sea-level rise as a result of

to tides, weather and climate variability

climate change alone. Climate change causes changes in sea level at a global

scale, primarily due to thermal expansio

of diaciers, ice caps and ice sheets on

land with increased run-off to the sea.

Temperature: Scientists are very

confident that the intensity and from enc.

of extreme heat will continue to increase for the rest of the 21st century. Events

that are considered a heat wave in the

longer, but the exact range of extreme

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

heat temperatures is still uncertain.

current climate are projected to become

What might happen

in the future?

of water as the oceans warm, and melting

can be quite large at any one time

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?

or longer-term climatic events that are rare or uncommon in occurrence, and

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

El Niño Southern Oscillation (ENSO), the South Pacific Convergence Zone (SPC2), the West Pacific Monsoon (WPM) and the Intertropical Convergence Zone (ITC2).

Longer-term variability and climate change

What has happened in the past?

compound these impacts, particularly terms of increased vulnerability to

Temperature: There have been more

frequent hot days and warm nights

natural, climate-related disasters.

often excessively severe in impact.

Climate extremes are short-term weather

Ocean acidification in t

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and Adaptation Planning Program (PACCSAP)

e changing seawater chemistry of 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 marine ecosystems, and to coastal 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 theraby increasing pH. Carbon dioxide is a weak acid, so when it enters the ocean it reacts with seawater, increasing acidity. What are th Calcium ca aragonite) is hard reef stru Oceans absorb about 25% of the carbon dioxide that is emitted into the atmosphere is strongly in saturation st of aragonite annually. As more carbon dioxide enters the atmosphere more carbon diovide is

olved in the oceans. This proces high and me a key role in reducing the rate of global suggest it w ming and therefore climate change other marine but it also changes the chemistry of the hard skale oceans. Carbonate (ion) is one form in which carbon is stored in the ocean, and Global clim which carbon is a critical in the observe and is a critical requirement for coral growth. Increased acidity will result in less carbonate (on) availability in the ocean to support coral growth. This poses a significant reafs in the y only stop and threat to the diversity, productivity and as they dis overall health of vulnerable, high-value · As corais be aquatic ecosystems, including coral reef ructures and associated fisheries, aqui sources and marine biodiversity. become m and coral bi more vulnera



presence of large-scale climation leads to profound year-to-yea small island nations dotted th What large-scale features drive the climate of the western tropical Pacific? Sea-level rise in the western tropical Pacific The major large-scale climate feature Southern Oscillation (ENSO), the Sou Pacific Convergence Zone (SPCZ), the Sea level is affected by tides, weather and natural climate variabilit Intertropical Convergence Zone (ITC2) and the West Pacific Monsoon (WPM) as well as climate change. A small amount of overall, long-term sea

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Large-scale climate features in the

and Adaptation Planning Program (PACCSAP)

(Fig. 1). These features affect the regio pattern and seasonal cycle in rainfall, v tropical cyclone tracks, ocean currents level rise due to climate change will compound the effects of natural variability and cause extreme sea levels to happen more often. nutrients and many other aspects of th What factors affect sea level? climate and the environment in genes Sea levels change daily, monthly and

western tropic

The Pacific Ocean covers al

El Niño Southern Oscillation annually due to a combination of tides weather and climate variability. The El Niño Southern Oscillation is the major influence on climate variability in Perhaps the most familiar change in sea the western tropical Pacific. It particu level is from daily tidal fluctua affects the year-to-year risk of drought extreme rainfall and floods, tropical cy by the gravitational pull of the sun and extreme sea levels and coral bleaching During normal conditions, when ENSC in its 'neutral' phase, the equatorial to









wave rullut

storm tide level

wave runup

wave set

wave setup over reef fla



al distribution of sea-level rise for the period from January 1993 to 5 vlogy and CSIRO, 2011 Climate Change in the Pacific: Scientific

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and Adaptation Planning Program (PACCSAP)

the moon on the Earth. Over the course

of any year, unusually large (king') tides can occur, but all tides are natural and

generally periodic and predictable events

extreme conditions. For example, storm

Weather and climate variability also

surge caused by tropical cyclones

affect sea level, particularly unde

As oceans warm, the water expands 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 atmospheric temperatures have caused most glaciers, ice caps and ice sheets on land to melt at an accelerating rate. This increased run-off to the sea has contributed to

can cause a change in local sea leve

that may be up to several metres or

more at a particular time and place.

Climate variability due to seasonal change

and large-scale climate features such as the El Niño Southern Oscillation (ENSO) can lead

to overall changes in trade wind patterns and

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 sea-

level extremes, resulting in flooding, erosion and other serious impacts to

poastal resources and infrastructure

Climate change and sea-level rise

Climate change causes changes in sea

evel at a global scale, primarily due to thermal expansion and melting polar ice

sea-level rise (note that melting of s ice does not cause sea-level rise). many locations, including the Pacific natural sea-level changes due to tides. weather and climate variability can be



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quite large at any one time compared to sea-level rise through climate change alone. A small amount of overall, long-



Australian Government



Fact Sheets (<u>http://www.pacificclimatechangescience.org</u>):

Atreme La Niña rainfall and associ ated flooding events in Vanuatu in May, 2008 L) and in Nadi, Fiji, in January, 2012 (bottom;



Climate variability & change

Large-scale climate processes









Historical and Simulated Mean annual Precipitation - Vanuatu



r auno-Australia Villiate Vilange Science and Auaptation Franking Program Australian Government

Vanuatu: Sea Level Projections



Technical Report – observed & projected wave climate



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Vanuatu: Marine Projections





Projected decreases in aragonite saturation state for Vanuatu

Year

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)	
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 (-1.0-0.4)	-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 (-1.4-0.9)	-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)	



Pacific-Australia Climate Change Science and Adaptation Planning Program

PACCSAP Science Program finishes in 2014

Post-PACCSAP future

- 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 GFCS Guidelines for developing a climate service

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 description
 - Coordination, collaborat
- What are the new and emergin
 - tailored/application-ready, multiple sectors, multiple risks, multiple time-mane, niner spatial scale, seamlessly interfaced to DSS!!??

Pacific-Australia Climate Change Science and Adaptation Planning Program Australian Government

Climate Service Information System

Research, Modelling Observations and and Prediction monitorina CAPACITY DEVELOPMENT



USERS

User Interface Platform





Thank you

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Australian Government

Department of the Environment



Australian Government

Bureau of Meteorology



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