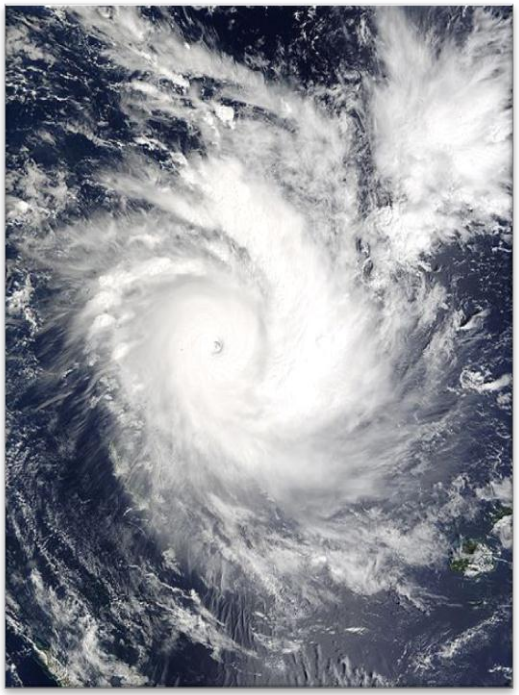
Australian Government
Geoscience Australia

Tropical Cyclone Risk Assessment in the Pacific Region

Examining the impacts of tropical cyclones on Pacific Island Nations – now and in the future



Australian Government

With financial support from the European Union
In the framework of the ACP-EU Natural Disaster Risk Reduction Program managed by the GFDRR

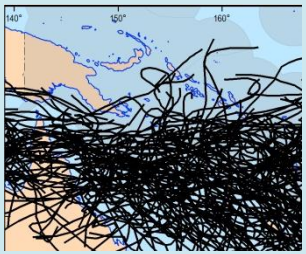
GFDRR

AIR WORLDWIDE

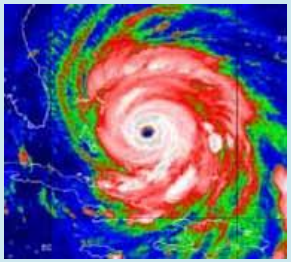
Australian AID

PCRAFI
Pacific Catastrophe Risk Assessment & Financing Initiative

Risk assessment framework – evaluating impacts



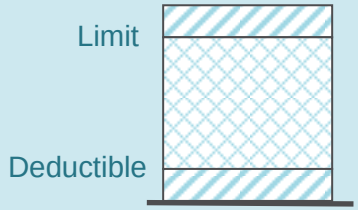
Event Generation



Intensity Calculation

Exposure Information

Damage Estimation

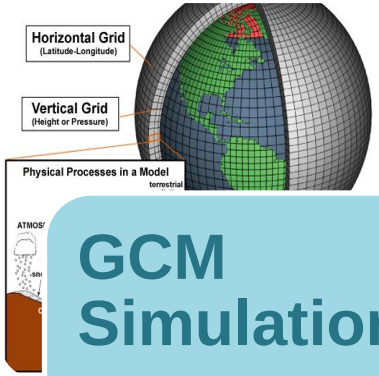


Mitigation / Policy Conditions

Loss Calculation

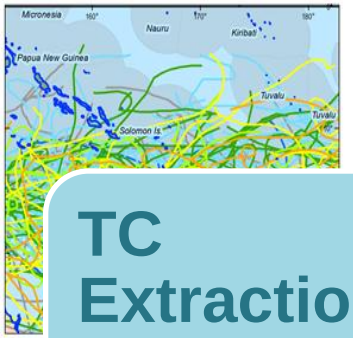
AIR

From General Circulation Models to Disaster Impacts



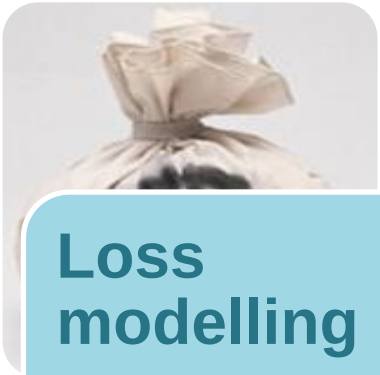
GCM Simulation

- 1981-2000 (current) and 2081-2100 (future)
- 6 CMIP3, 5 CMIP5 models



TC Extraction and analysis

- Identification and tracking
- Analysis of changes



Loss modelling

- Climate-conditioned catalogue
- Catastrophe modelling

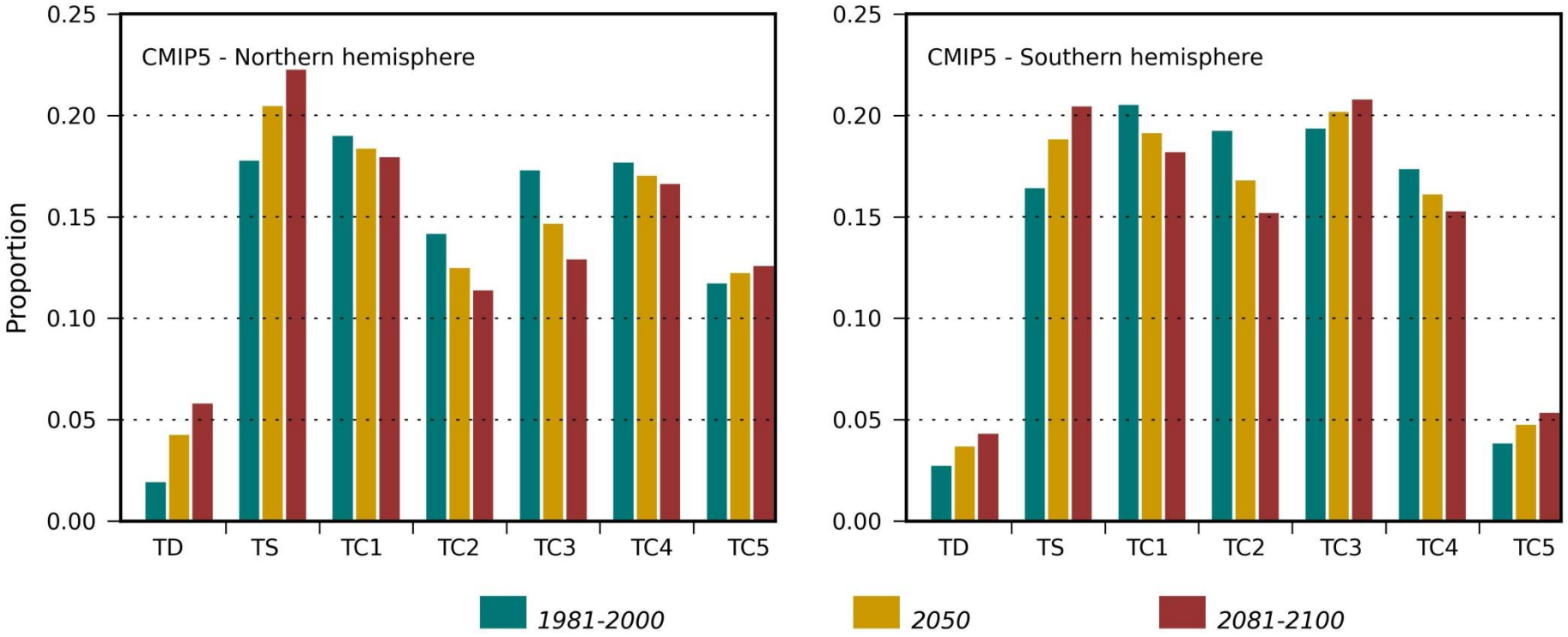
Peril matrices

Tropical cyclone frequency in the southern hemisphere – observed average of 13.2 TCs/year

Model name	Current climate (TCs/year)	Future climate (TCs/year)	Change (TCs/year)	Relative change
ACCESS10	13.6	11.3	-2.3	-17%
CanESM	13.6	16.1	2.7	19%
CSIROMk36	14.4	10.9	-3.5	***-24%***
IPSLCM5A	3.5	6.9	3.4	***100%***
NorESM1M	13.2	11.3	-1.9	-14%
CSIROMk35	8.9	4.1	-4.8	***-55%***
ECHAM5	13.0	4.1	-8.9	***-69%***
GFDLCM20	9.3	3.1	-6.2	***-67%***
GFDLCM21	9.9	3.6	-6.3	***-64%***
HadCM3	9.8	4.1	-5.7	***-58%***
MIROC32	7.1	1.6	-5.5	***-78%***

Bold, italic values are significant at the 5% level

Changes in TC intensity



**Categories based on Saffir-Simpson TC Intensity Scale*

Most models indicate an increase in the proportion of the most intense TCs

Changes in TC behaviour: 1990–2090

Southern hemisphere	CMIP3	CMIP5
Annual frequency	***-65%***	-2.9%
Mean intensity	-4.8%	-2.9%
Latitude of peak intensity	***-1.9°***	-0.3°
Proportion of cat 5 TCs	-14%	+40%

Northern hemisphere	CMIP3	CMIP5
Annual frequency	*-17%*	+11%
Mean intensity	+0.2%	-4.4%
Latitude of peak intensity	+0.2°	-0.4°
Proportion of cat 5 TCs	-0.3%	+7.4%

Bold values indicate a statistically-significant change;
Italics indicate the ensemble mean change is greater than the inter-model standard deviation

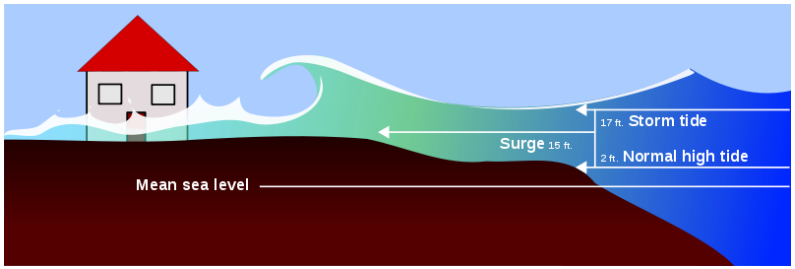
SOPAC Catastrophe model

Designed to capture effects of three tropical cyclone hazards:

- strong winds;
- precipitation-induced flooding; and
- coastal flooding due to storm surge.

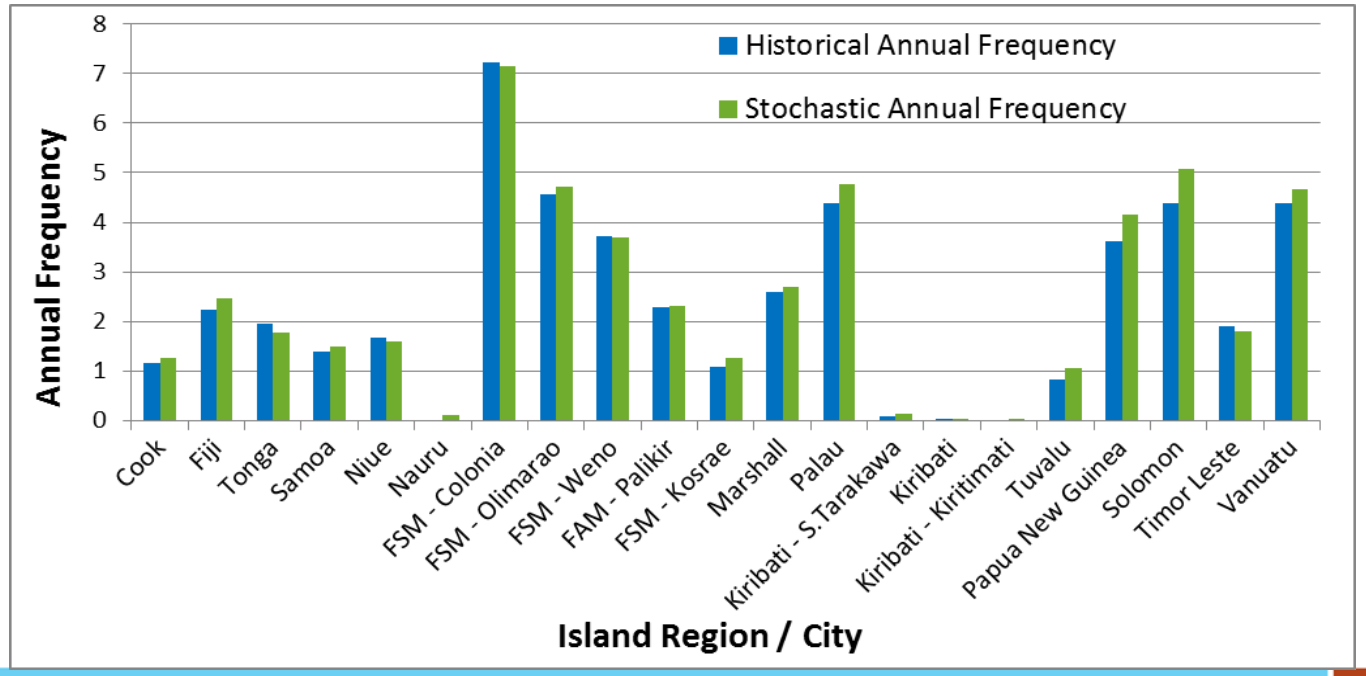
Reports losses to:

- buildings (residential, commercial, public, industrial);
- infrastructure (airports, ports, power plants, dams, major roads, bridges);
- crops (coconut, palm oil, sugarcane, rice, banana etc.); and
- people exposed to tropical cyclone risk.



SOPAC 10,000 Year Catalogue

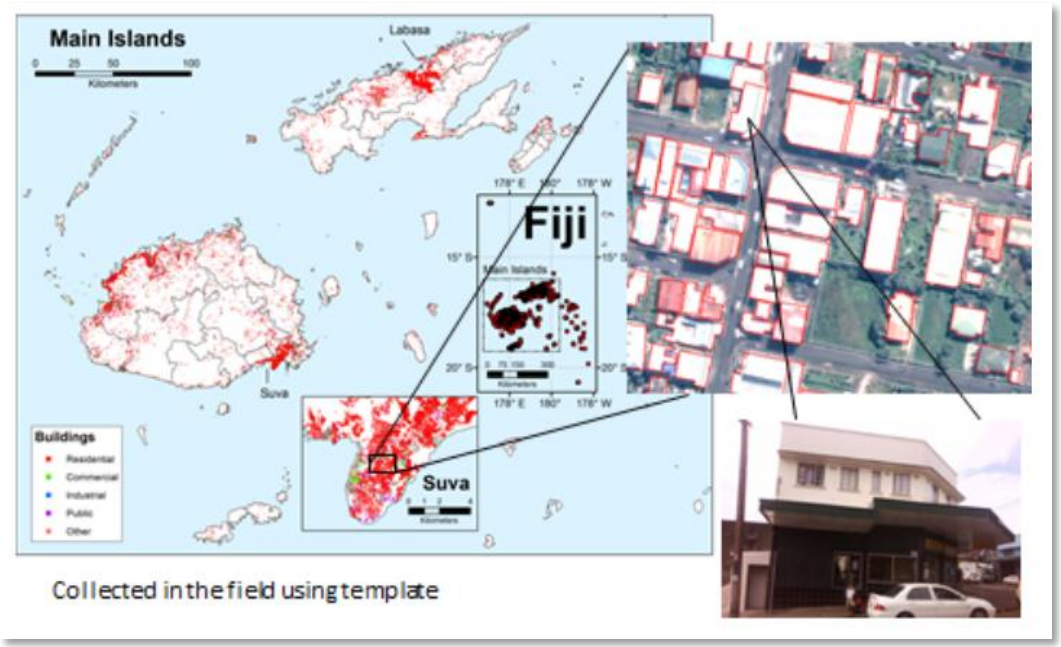
- Built to physically and statistically reflect the most credible long-term view of tropical cyclone risk
- Developed based on the historical record
- Represents an objective view of the current climate
- Validated for frequency, intensity and track evolution

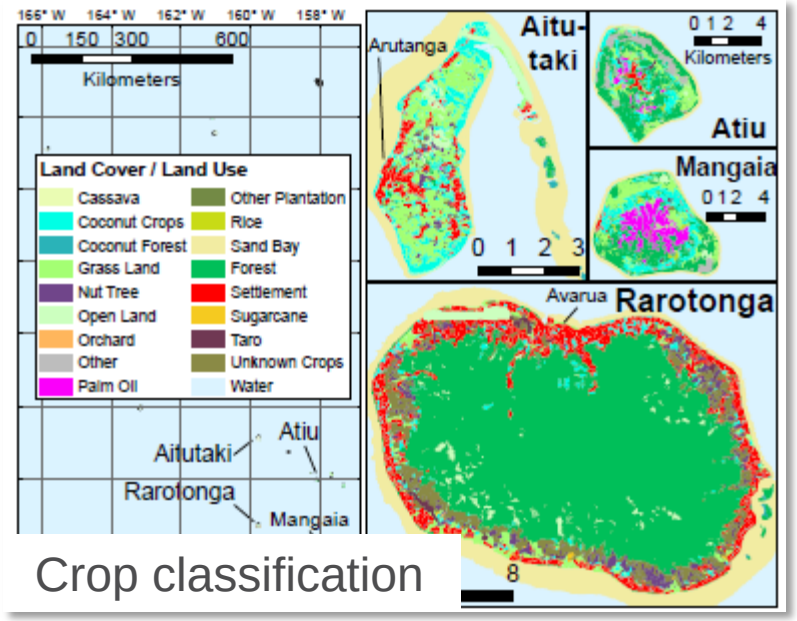


Exposure: the elements at risk

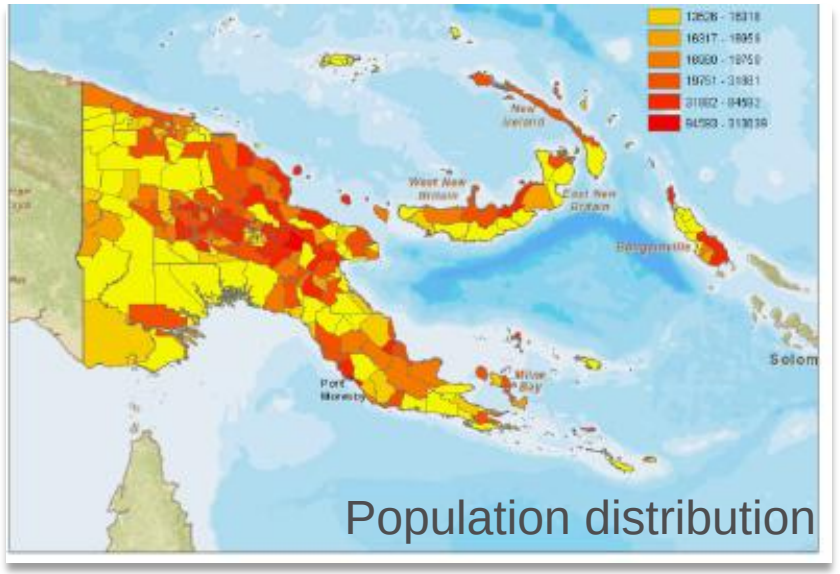
Information is stored in the PacRIS database

http://paris.sopac.org





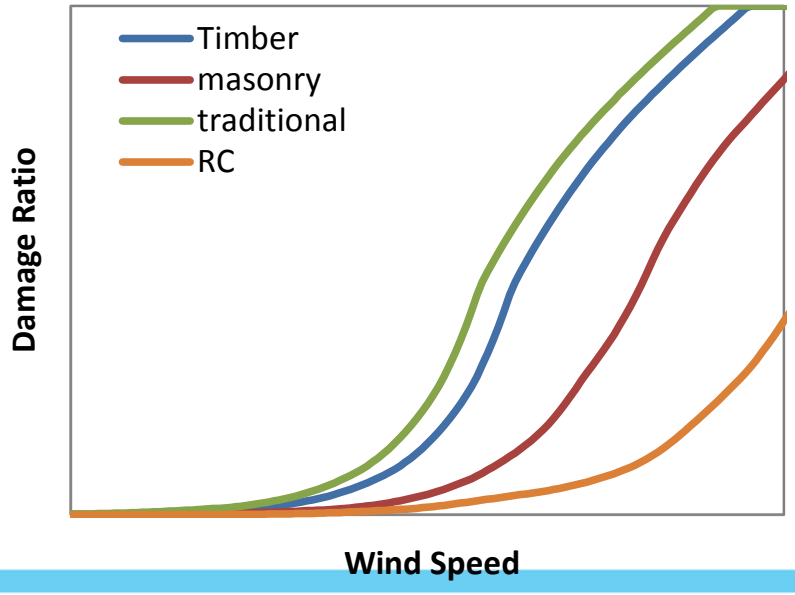
Crop classification



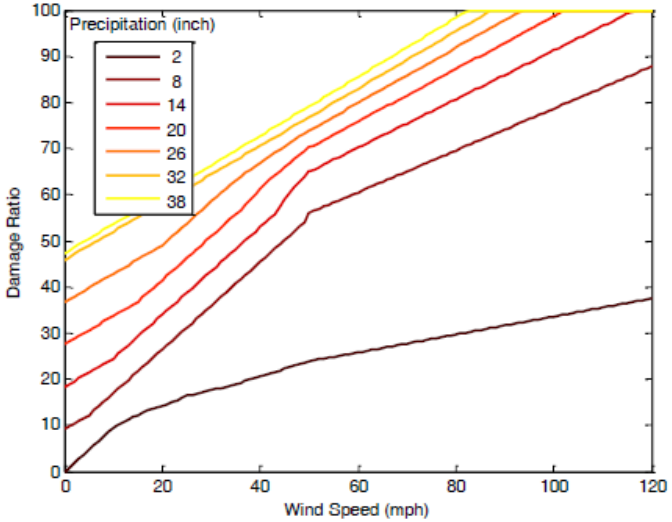
Vulnerability: how much damage?

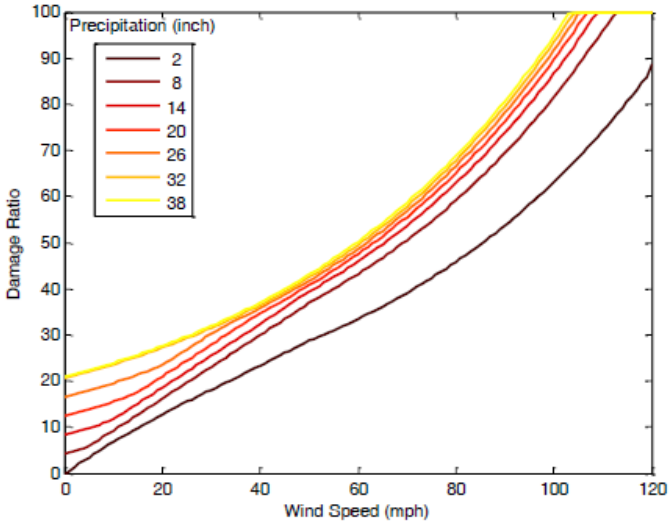
Different buildings, crops and infrastructure will be impacted to different levels for the same incident wind speed or water level (for flooding impacts)

Building DF



Crop DF





Current Climate Estimated Losses Across the Pacific

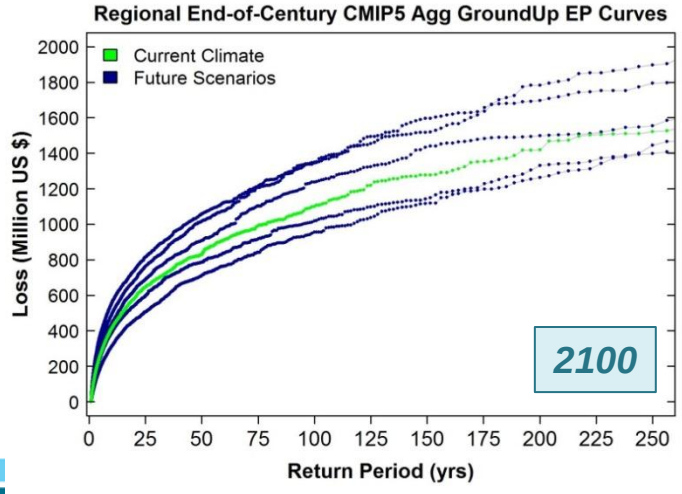
Asset	Average Annual Loss (AAL)
Ground Up	US $178,198,886
Buildings	US $111,198,476
Infrastructure	US $10,436,570
Crops	US $56,563,840
Population Affected	533

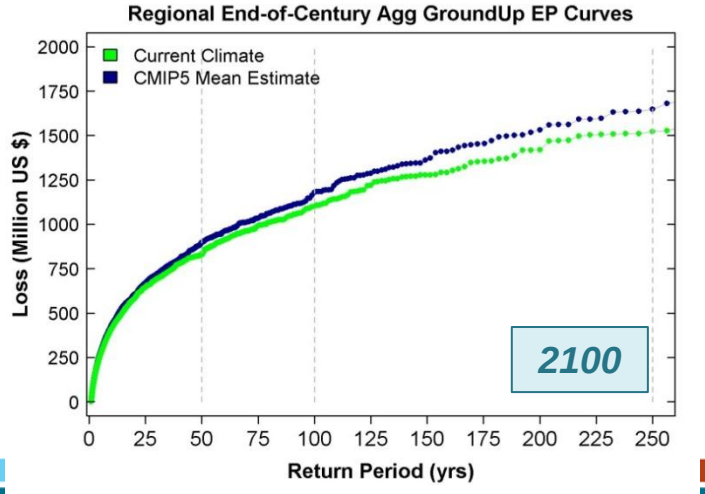
Ground Up	Loss
AAL	US $178,198,886
50 Year Return Period	US $829,003,877
100 Year Return Period	US $1,099,552,080
250 Year Return Period	US $1,523,057,384

All values are in U.S. dollars, based on 2010 values

Future Climate Average Annual Loss Changes Across the Pacific

Asset	CMIP5 Mean Estimate	
	2050	*2100*
Ground Up	1.0%	3.9%
Buildings	2.2%	6.3%
Infrastructure	-1.9%	1.3%
Crop	-0.7%	-0.3%
Population affected	0.6%	2.6%





Key results

TC behaviour

TC Frequency	• Slight increase in CMIP5 models • Significant decrease in CMIP3 models*
TC Tracks	• Little change in latitude • Climate drivers may impact where TCs form
TC Intensity	• Slight increase in proportion of category 5 TCs • Fewer mid-range TCs

TC losses

Ground Up losses	• 5% increase by end-century • Dominated by losses to buildings
Event impacts	• Decline in losses for more frequent events • Increased losses for rare events
Losses by peril	• Most building damage due to wind impacts • Flooding causes greatest damage to infrastructure

Informing adaptation options

Integrating risk into planning decisions

Addressing the adaptation deficit

Infrastructure design and maintenance

Managing the costs of disasters

Australian Government
Geoscience Australia

Tropical Cyclone Risk Assessment in the Pacific Region

For more information visit

www.climatechange.gov.au/climate-change/adapting-climate-change

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