APCC Conference 11 -13 November 2013

Supporting drought in Pacific Island Countries

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and with thanks to Bureau colleagues

Aims

"Pacific Island Countries have skills and information to adapt to climate variability and change, contributing to sustainable livelihood."

"Pacific Island NMSs and other relevant in-country agencies understand and use climate, ocean and sea level products for the benefit of island communities and governments."

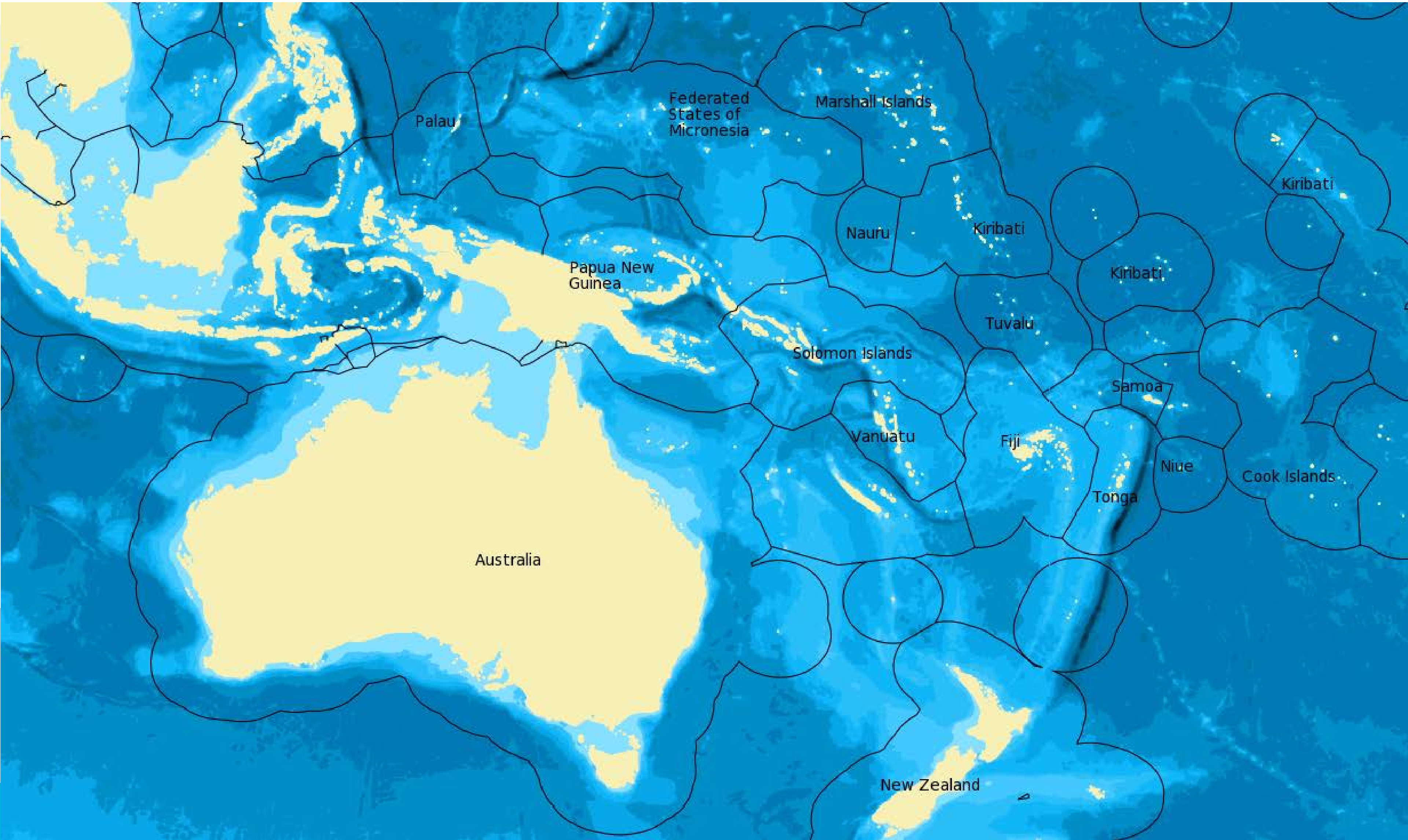
Climate and Oceans Support Program in the Pacific (COSPPac) is one of the agencies working with Pacific Island Countries to further these aims.

COSPPac components

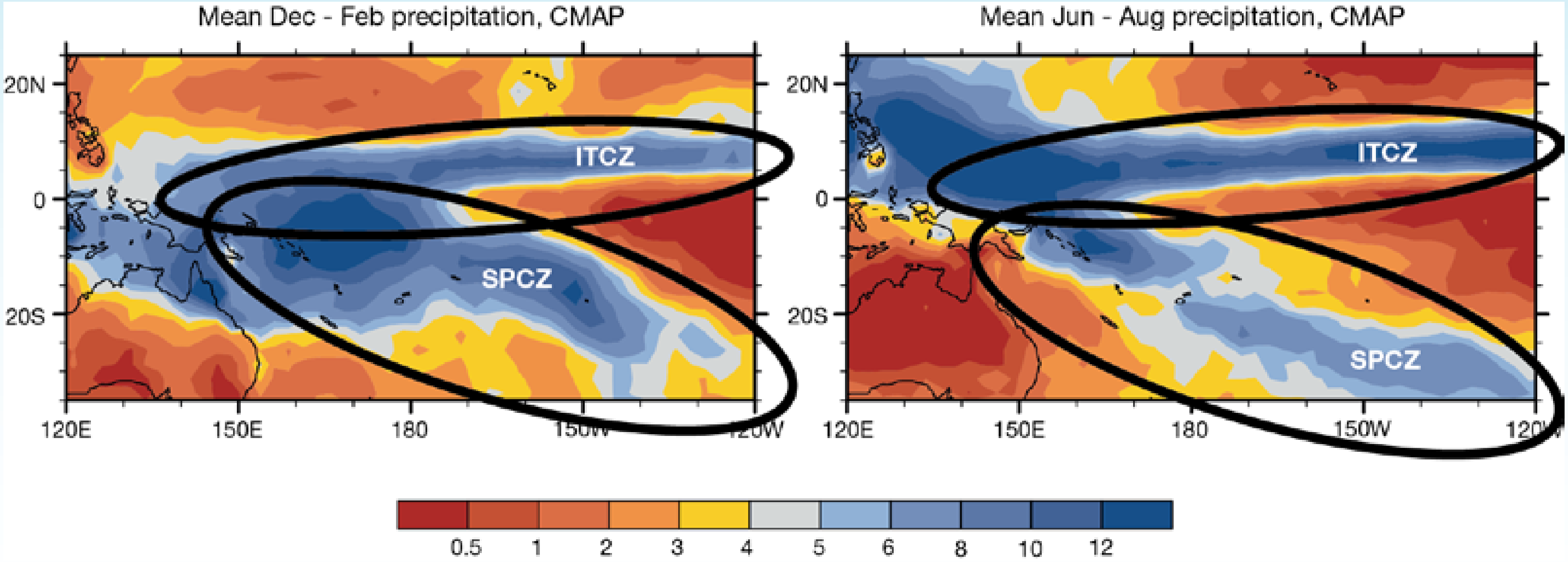
COSPPac Management Unit (CMU)

- **Climate and Ocean Monitoring and Prediction (COMP)**
- **Capacity Development and Communication (CD&C)**
- **Pacific Sea Level Monitoring (PSLM)**

Countries in COSPPac



Annual rainfall variability



www.pacificclimatechangescience.org/publications/reports/

Rainfall variability and ENSO

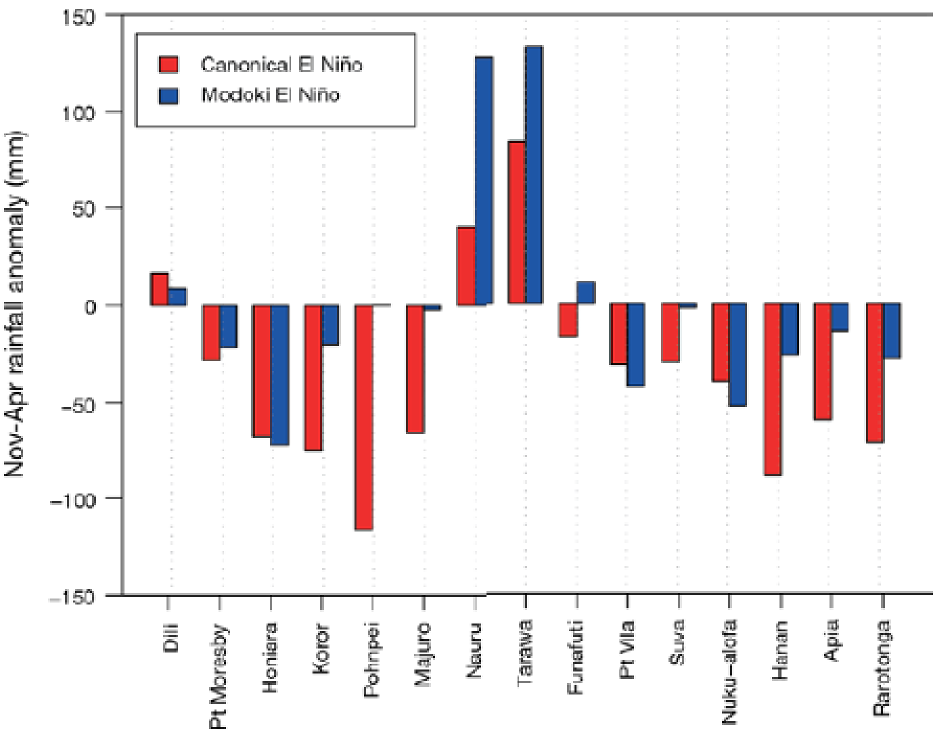


Figure 3.4: For sites in each Partner Country, differences between normal November to April rainfall and average rainfall during (red) Canonical El Niño events (years 1965, 1972, 1977, 1982, 1997, 2006, 2009) and (blue) Modoki El Niño events (years 1986, 1990, 1991, 1992, 1994, 2002, 2004).

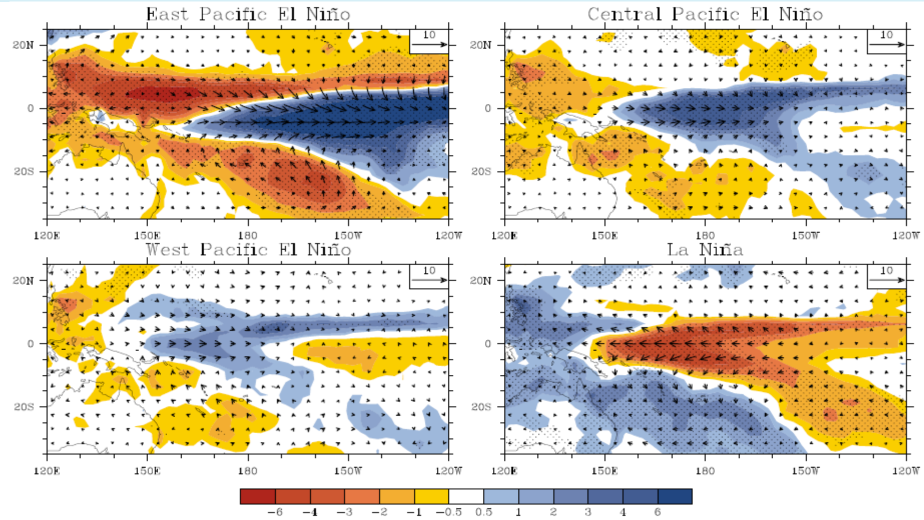


Figure 3: Mean Nov-Apr rainfall anomalies for the 3 El Niño types and for La Niña events. Arrows show the corresponding surface wind anomalies for Sep-Feb. Stippling denotes where the rainfall anomalies are statistically significantly different from zero at the 90% confidence level. Rainfall data are from the GPCP analysis and wind data are from the ERA-Interim reanalysis, 1979-2010.

Brad Murphy et al.
J. Climate in review

www.pacificclimatechangescience.org/publications/reports/

Projected changes in rainfall

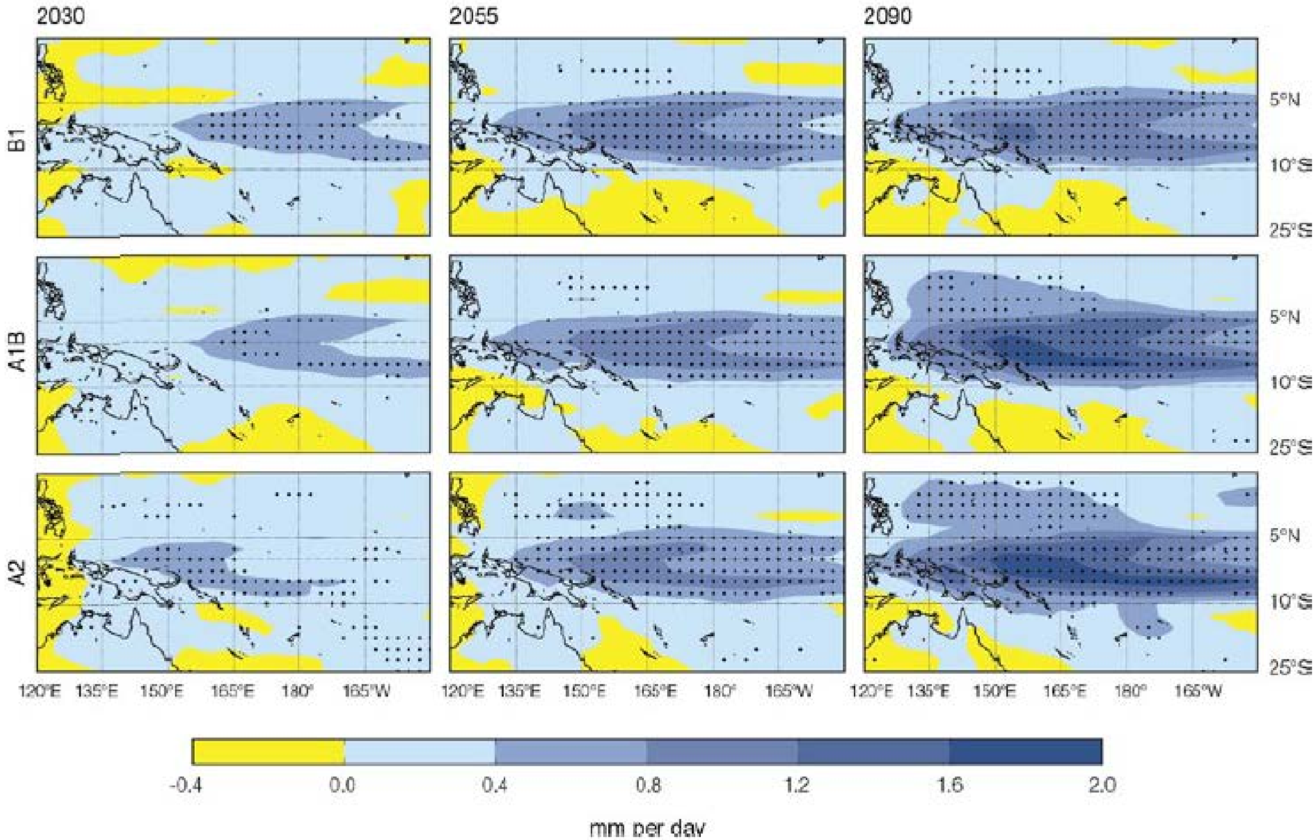
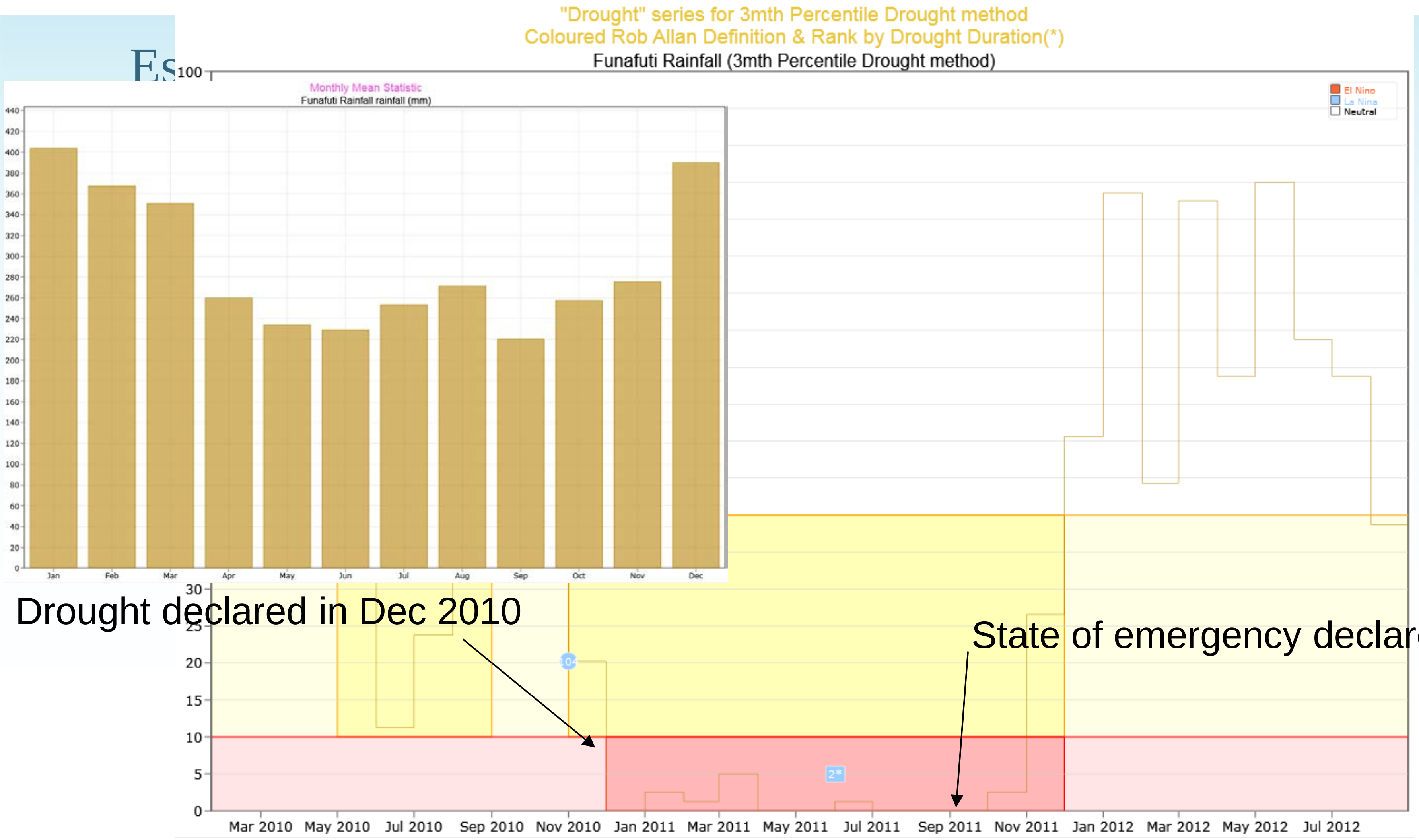


Figure 6.3: Projected multi-model mean changes in annual rainfall (mm per day) for 2030, 2055 and 2090, relative to 1990, under the B1 (low), A1B (medium) and A2 (high) emissions scenarios. Regions where at least 80% of models agree on the direction of change are stippled.

www.pacificclimatechangescience.org/publications/reports/

Why monitor drought?



Drought declared in Dec 2010

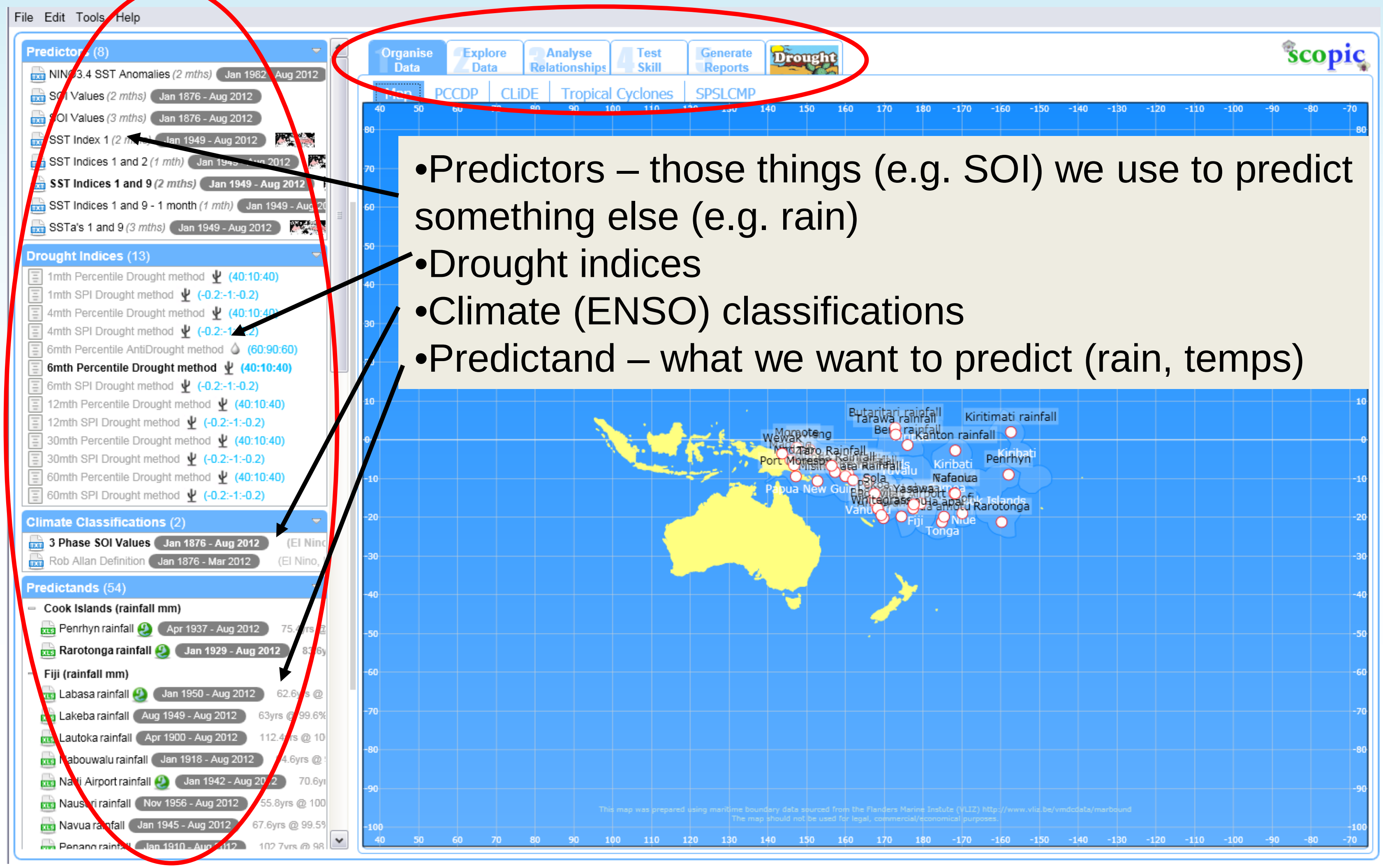
State of emergency declared

SCOPIC tool

Seasonal Climate Outlook for Pacific Island Countries (SCOPIC)

- PC based program – little computing resources needed
- Point forecast to one location – single rainfall record but must be good quality
- Statistical forecasts based on an Index of ENSO
- Verification statistics
- Generates reports, can be tailored to local language
- Contains ability to further analyse rainfall through a drought module

SCOPIC tool



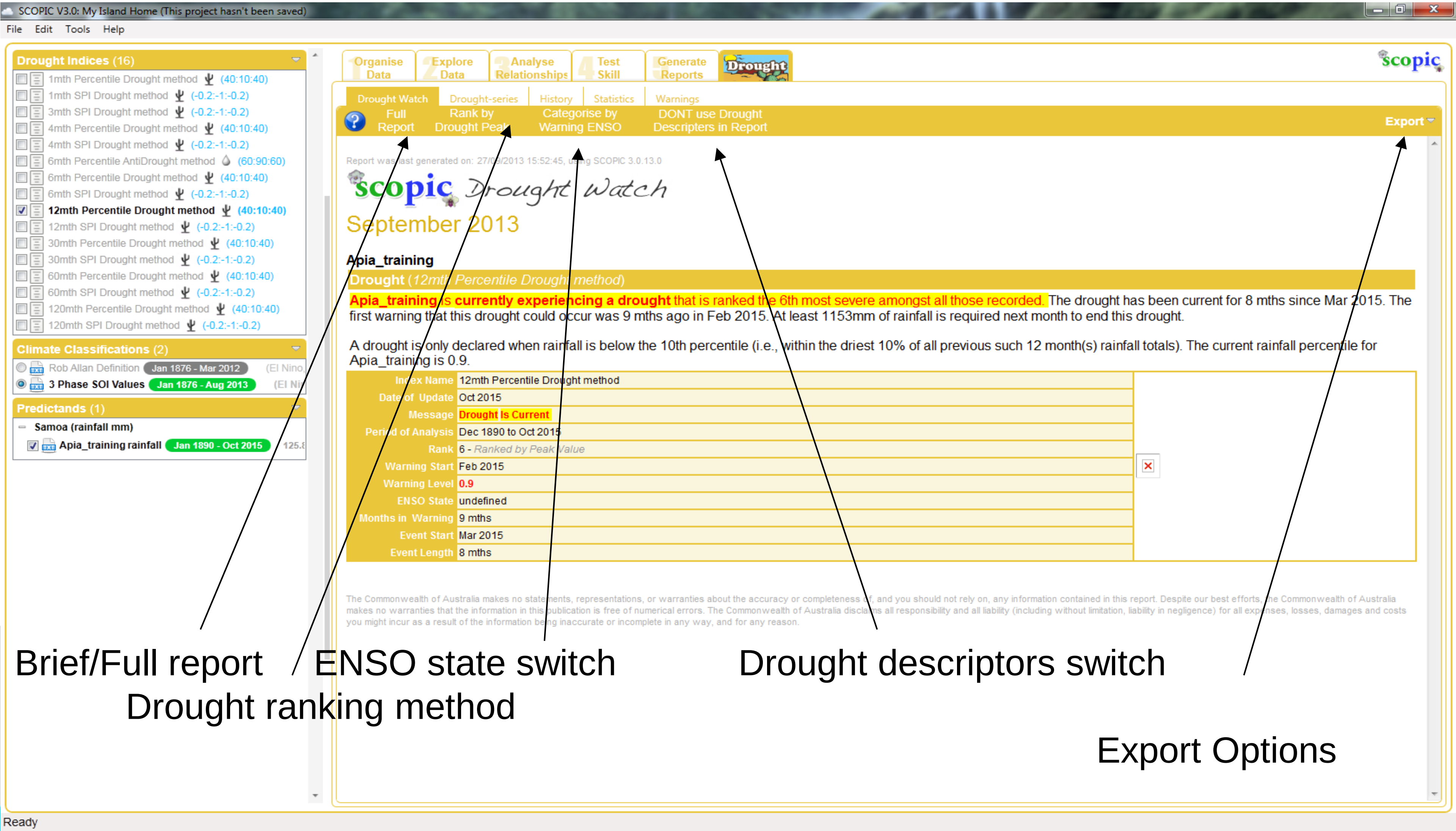
- Predictors – those things (e.g. SOI) we use to predict something else (e.g. rain)
- Drought indices
- Climate (ENSO) classifications
- Predictand – what we want to predict (rain, temps)

Drought monitoring tool

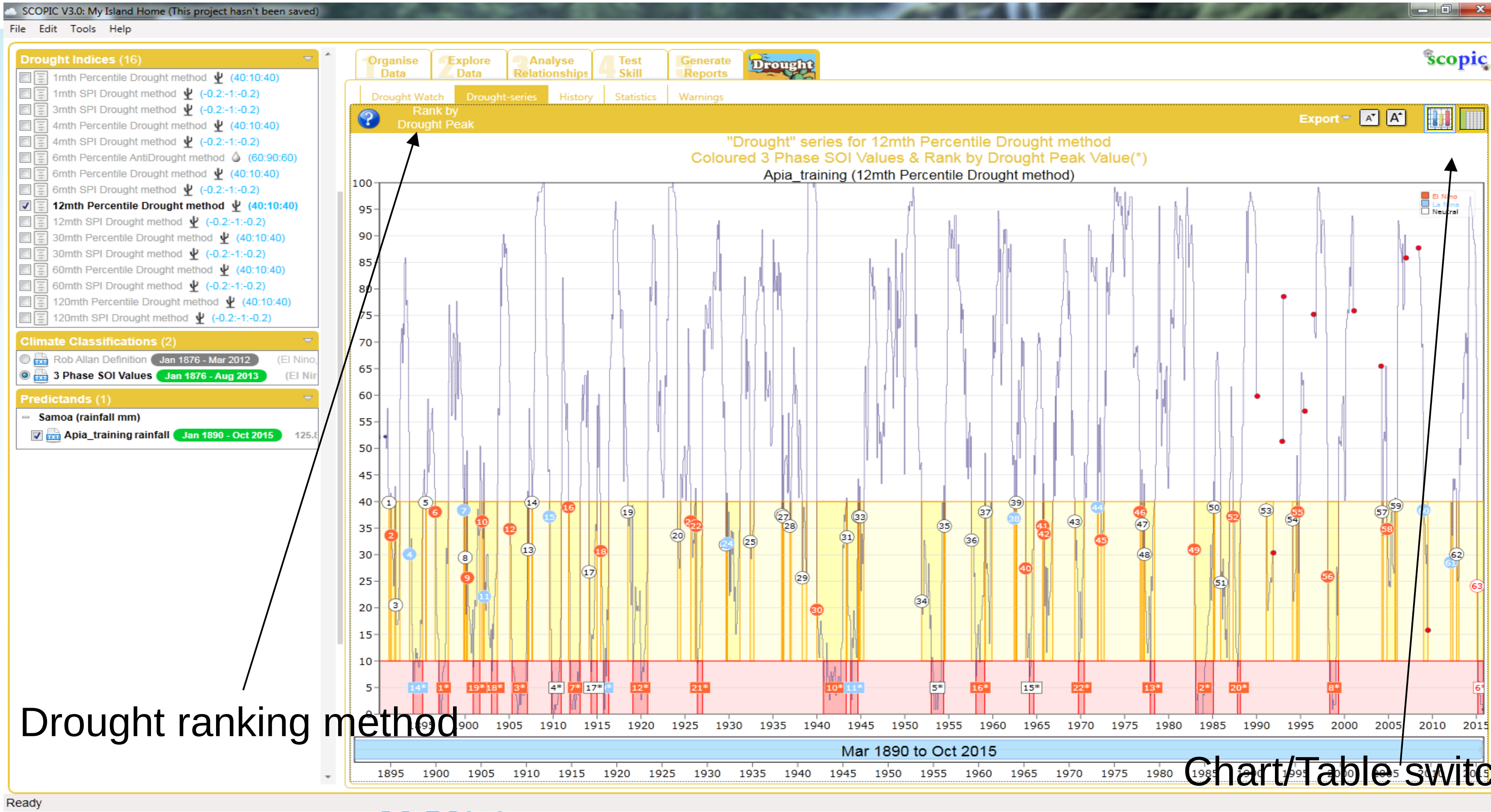
Using the drought module in SCOPIC as a tool for monitoring drought and warning of drought conditions:

- Different averaging periods available depending on purpose, e.g. for South Tarawa in Kiribati 4-6 months for rain tanks, 12-30 for domestic wells and 60-120 months for large freshwater lenses (White et al 1999)
- Tools to examine rainfall/droughts in historical context including breakdown with ENSO conditions.
- Provides drought warnings and drought declarations based on pre-determined levels of rainfall received.

Drought (Drought Watch)



Drought (Drought Series)



Drought ranking method

Chart/Table switch

Drought (Drought History)

SCOPIC V3.0: My Island Home (This project hasn't been saved)

File Edit Tools Help

Drought Indices (16)

- 1mth Percentile Drought method (40:10:40)
- 1mth SPI Drought method (-0.2:-1:-0.2)
- 3mth SPI Drought method (-0.2:-1:-0.2)
- 4mth Percentile Drought method (40:10:40)
- 4mth SPI Drought method (-0.2:-1:-0.2)
- 6mth Percentile AntiDrought method (60:90:60)
- 6mth Percentile Drought method (40:10:40)
- 6mth SPI Drought method (-0.2:-1:-0.2)
- 12mth Percentile Drought method (40:10:40)
- 12mth SPI Drought method (-0.2:-1:-0.2)
- 30mth Percentile Drought method (40:10:40)
- 30mth SPI Drought method (-0.2:-1:-0.2)
- 60mth Percentile Drought method (40:10:40)
- 60mth SPI Drought method (-0.2:-1:-0.2)
- 120mth Percentile Drought method (40:10:40)
- 120mth SPI Drought method (-0.2:-1:-0.2)

Climate Classifications (2)

- Rob Allan Definition Jan 1876 - Mar 2012 (El Nino,
- 3 Phase SOI Values Jan 1876 - Aug 2013 (El Nir

Predictands (1)

- Samoa (rainfall mm)
  - Apia_training rainfall Jan 1890 - Oct 2015 125.8

Organise Data | Explore Data | Analyse Relationships | Test Skill | Generate Reports | Drought

Drought Watch | Drought-series | History | Statistics | Warnings

Rank by Drought Peak | Categorise by Warning ENSO | Export

Report was last generated on: 27/09/2013 15:54:08, using SCOPIC 3.0.13.0

scopic *Drought History*

Apia_training (Dec 1890 to Oct 2015)

12mth Percentile Drought method

ENSO States defined using 3 Phase SOI Values (Assigned at Warning Start)

Rank*	Drought Period	Drought Length	Drought Peak	Drought Integral	Warning Start	Warning Length	Warning ENSO State	Drought ENSO State	Actual Recovery rainfall
1	Jan 1897 to Jan 1898	13mths	0%	41.3	Aug 1896	5mths	El Nino	El Nino	3016
2	Feb 1983 to Jan 1985	24mths	0%	102.4	Dec 1982	2mths	El Nino	El Nino	4668.4
3	May 1905 to Jan 1907	21mths	0%	106.8	Feb 1905	3mths	El Nino	El Nino	3396
4	Nov 1909 to Nov 1910	13mths	0%	78.1	Aug 1909	3mths	La Nina	Neutral	2507
5	Jan 1953 to May 1954	17mths	0.9%	70.5	Dec 1951	13mths	Neutral	Neutral	3571.4
6	Mar 2015 to Oct 2015	8mths	0.9%	53.5	Feb 2015	1mth			929
7	Dec 1911 to Jan 1913	14mths	0.9%	78.7	Oct 1911	2mths	El Nino	El Nino	2559
8	May 1998 to Apr 1999	12mths	0.9%	50.8	Feb 1998	3mths	El Nino	El Nino	2535.6
9	Oct 1915 to Apr 1916	7mths	0.9%	15.8	Jun 1915	4mths	El Nino	La Nina	2177
10	Oct 1940 to Apr 1943	31mths	2.6%	88.2	Jan 1940	9mths	El Nino	El Nino	6052.5
11	Nov 1943 to Aug 1944	10mths	2.7%	7.5	Jun 1943	5mths	Neutral	La Nina	2208.2
12	Feb 1919 to Sep 1920	20mths	2.7%	12.7	Jul 1918	7mths	Neutral	El Nino	3593
13	Dec 1977 to May 1978	6mths	3.5%	6.5	Apr 1977	8mths	Neutral	El Nino	2173.8
14	Feb 1894 to Feb 1895	13mths	5.4%	11.3	Sep 1893	5mths	La Nina	La Nina	2750
15	Mar 1964 to Aug 1964	6mths	7.1%	4.1	Oct 1963	5mths	El Nino	Neutral	1449.6
16	Feb 1958 to Jan 1959	12mths	7.1%	3.1	Aug 1957	6mths	Neutral	El Nino	2522.1
17	May 1914 to Dec 1914	8mths	8%	2	Feb 1914	3mths	Neutral	Neutral	1698
18	Jan 1903 to Aug 1903	8mths	8%	2	Mar 1902	10mths	La Nina	El Nino	2168
19	Dec 1900 to Aug 1901	9mths	8.8%	1.2	Apr 1900	8mths	El Nino	El Nino	2220
20	Nov 1987 to Feb 1988	4mths	8.9%	1.1	May 1987	6mths	El Nino	El Nino	1826.3
21	Jun 1926 to Dec 1926	7mths	9.6%	0.4	Apr 1926	2mths	El Nino	El Nino	1535.9
22	Oct 1969 to May 1970	8mths	9.7%	0.3	May 1969	5mths	Neutral	El Nino	2188

*NB: Ranking is based upon the Peak Value method.

Ready

Historical table

Drought (Drought Statistics)

Drought Watch | Drought-series | History | Statistics | Warnings

Categorise by Warning ENSO

Export

Report was last generated on: 13/08/2013 14:57:47, using SCOPIC 3.0.12.0

scopic *Drought Statistics*

Apia (Jun 1890 to Jul 2013)

6mth Percentile Drought method -

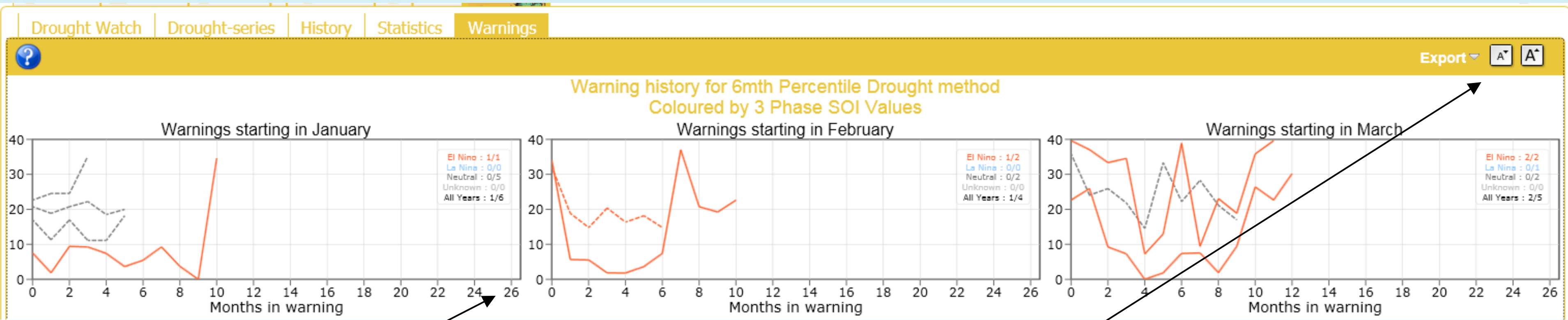
ENSO States defined using 3 Phase SOI Values (Assigned at Warning Start)

DroughtStatistics

In-Drought Durations	All Events	El Nino	La Nina	Neutral
Number of Droughts	37	20	3	14
Total Months In Drought	299 mths	179 mths	21 mths	99 mths
Drought Lengths	1 to 29 mths	1 to 29 mths	2 to 14 mths	1 to 19 mths
Average Drought Lengths	8.1 mths	9 mths	7 mths	7.1 mths
CV	73.7%	76.2%	72.8%	62.2%
In-Drought rainfall	**All Events**	**El Nino**	**La Nina**	**Neutral**
Lowest In-Drought rainfall	155 mm	155 mm	399 mm	225 mm
Highest In-Drought rainfall	4590.3 mm	4590.3 mm	2291.8 mm	3599 mm
Mean In-Drought rainfall	1499.7 mm	1572.6 mm	1202.9 mm	1459.1 mm
CV	65.4%	68.7%	66.4%	57.6%
Between-Drought Lengths	**All Events**	**El Nino**	**La Nina**	**Neutral**
Between-drought lengths	4 to 136 mths	4 to 136 mths	10 to 49 mths	4 to 102 mths
Average between-drought length	33.1 mths	39.3 mths	29.7 mths	25.5 mths
CV	95.6%	93%	53.7%	95.9%

Historical table

Drought (Drought Warnings)



Graph for each month

Export options

Graphs are colour coded (ENSO)

Dashed remained above drought threshold

Pilot national drought response plans

Current pilot plans for Fiji Met Service and Kiribati Met Service

Collaboration between local Met service, agricultural and hydrological services and government or relevant disaster agencies.

Met service provides evaluation of rainfall and communicates with relevant sectors to confirm drought conditions and then with government.

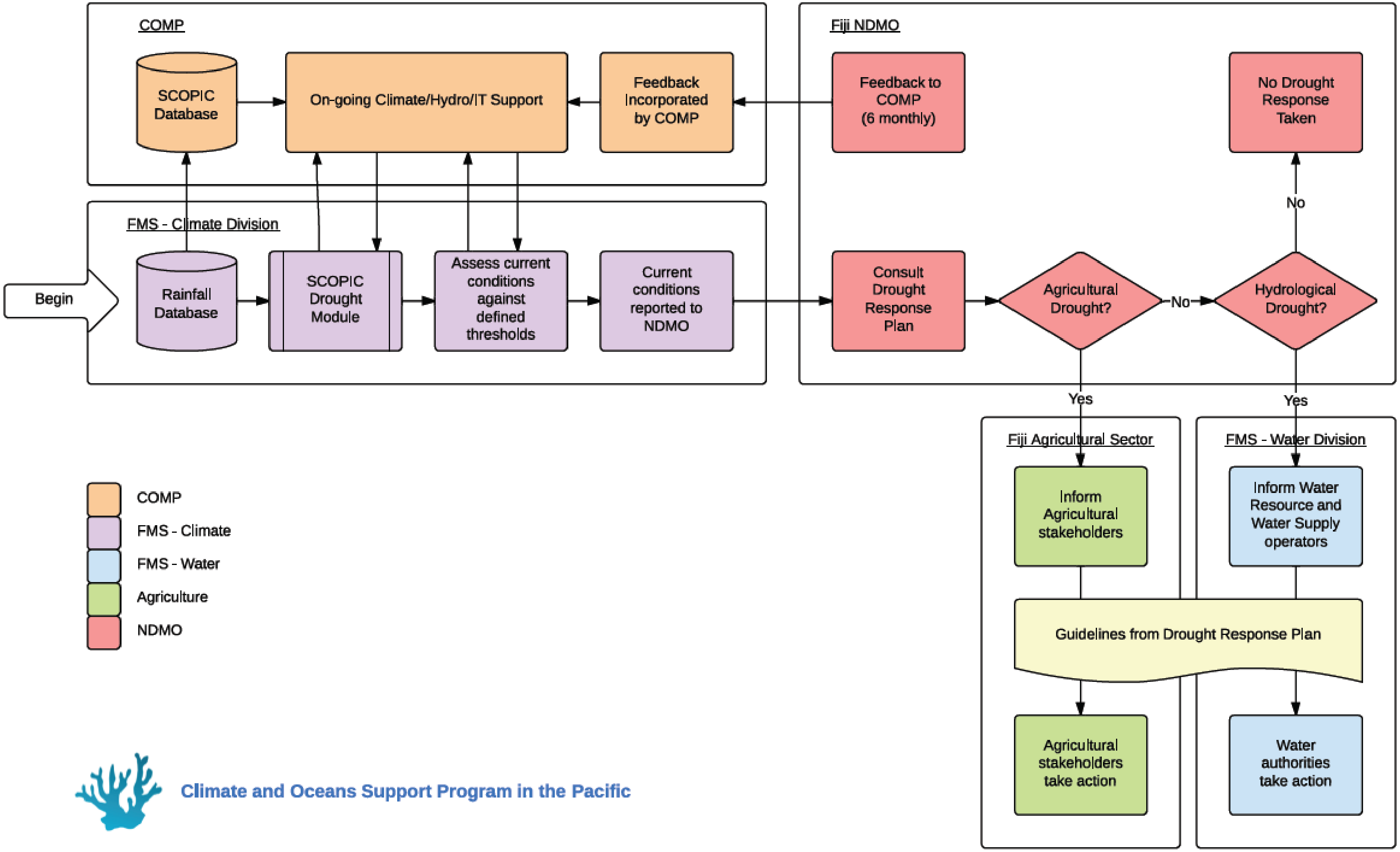
Drought response plan

Using the drought module as a tool for Pacific country drought response plans:

- Default section and new tailored to country or sector-specific section.
- Calculation of rainfall required to get out of drought and climatological probability of getting that rainfall.
- Default periods of 4, 12 and 36 months.
- new drought **watch** when rainfall drops below 40th percentile
- New drought **warning** threshold at the 25th percentile to limit number of false alarms on drought warnings.

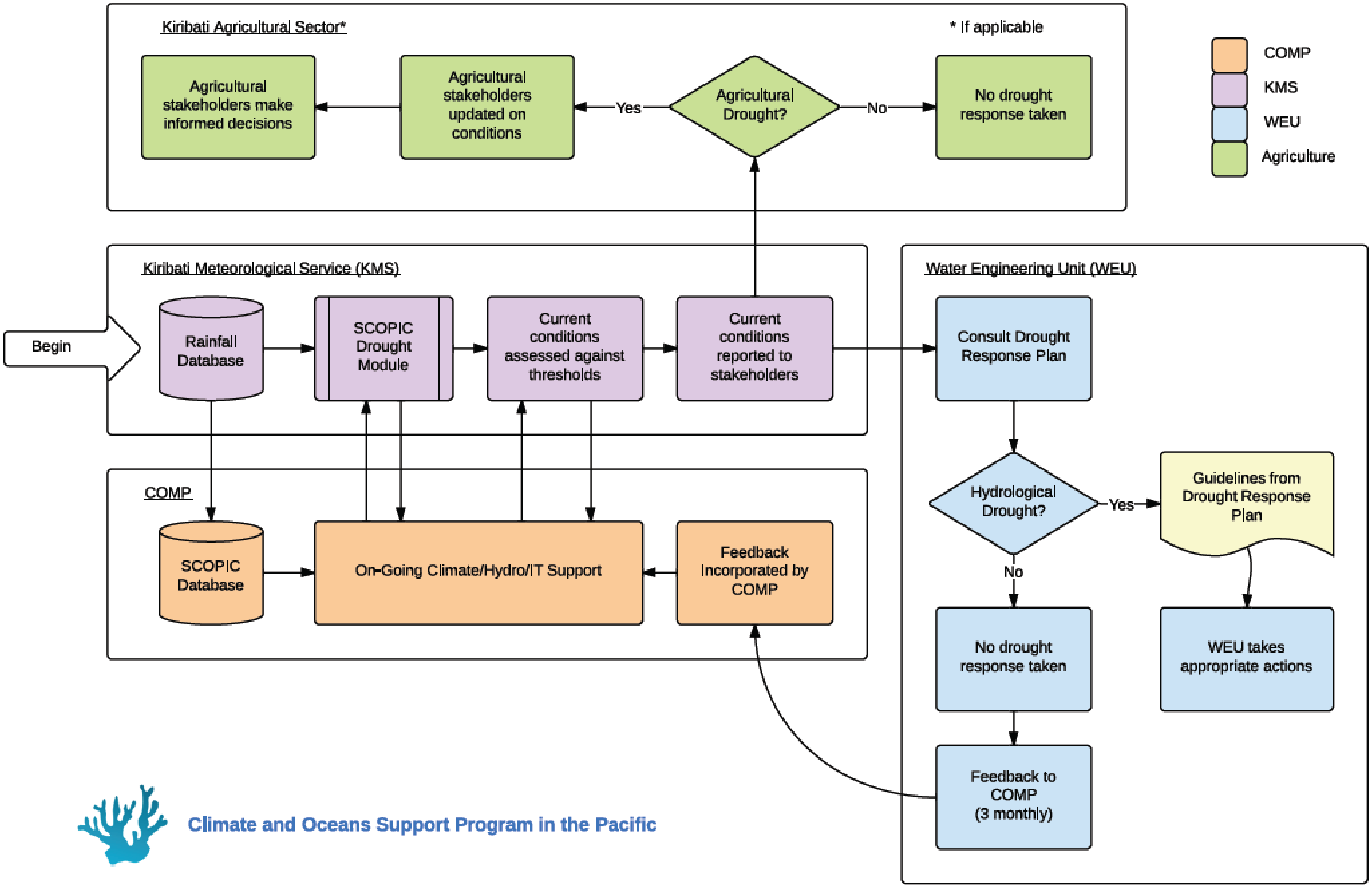
Fiji drought response plan

Schematic of an Operational System - Drought Monitoring in Fiji



Kiribati drought response plan

Schematic of an Operational System - Drought Monitoring in Kiribati



Concluding remarks

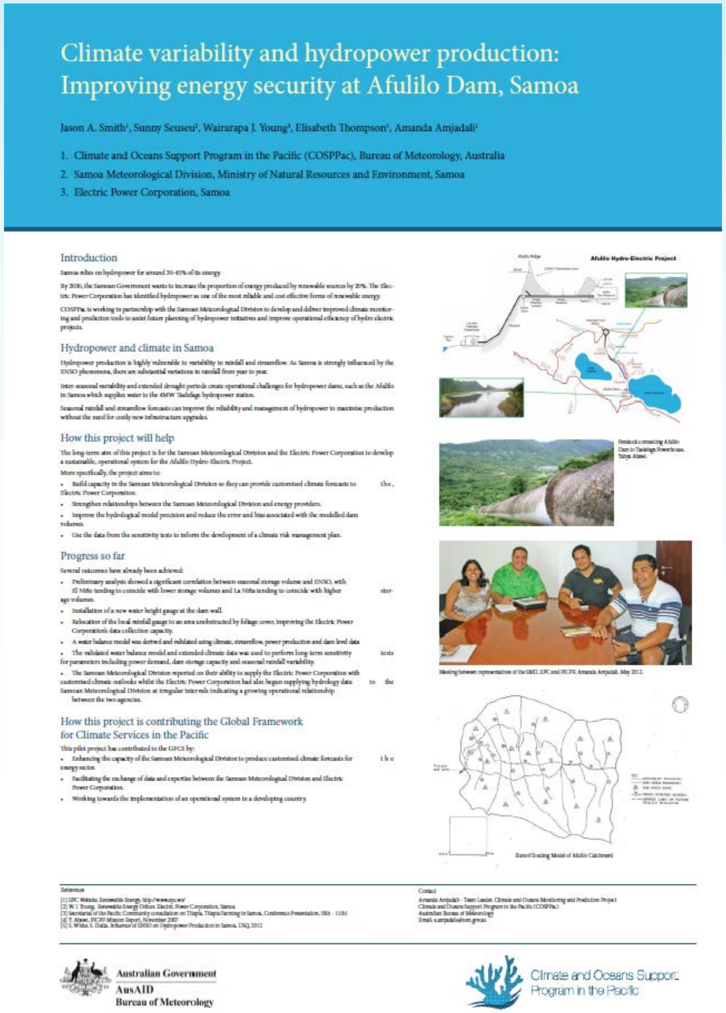
Drought is a common feature of the Pacific Island climate.

The drought tool in the SCOPIC program gives users the ability to analyse past rainfall and issue drought warnings based on current conditions.

COSPPac is working with Pacific Island countries to build response plans around drought.

COSPPac components

Collaborative science and policy papers



Climate variability and hydropower production: Improving energy security at Afulilo Dam, Samoa

Jason A. Smith[1], Sunny Seuseu[2], Wairarapa J. Young[3], Elisabeth Thompson[1], Amanda Amjadali[1]

1. Climate and Oceans Support Program in the Pacific (COSPPac), Bureau of Meteorology, Australia
2. Samoa Meteorological Division, Ministry of Natural Resources and Environment, Samoa
3. Electric Power Corporation, Samoa

Introduction

Samoa relies on hydropower for around 30-45% of its energy.

By 2030, the Samoan Government wants to increase the proportion of energy produced by renewable sources by 20%. The Electric Power Corporation has identified hydropower as one of the most reliable and cost effective forms of renewable energy.

COSPPac is working in partnership with the Samoan Meteorological Division to develop and deliver improved climate monitoring and prediction tools to assist future planning of hydropower initiatives and improve operational efficiency of hydro electric projects.

Hydropower and climate in Samoa

Hydropower production is highly vulnerable to variability in rainfall and streamflow. As Samoa is strongly influenced by the ENSO phenomena, there are substantial variations in rainfall from year to year.

Inter-seasonal variability and extended drought periods create operational challenges for hydropower dams, such as the Afulilo in Samoa which supplies water to the 4MW Taelefaga hydropower station.

Seasonal rainfall and streamflow forecasts can improve the reliability and management of hydropower to maximise production without the need for costly new infrastructure upgrades.

How this project will help

The long-term aim of this project is for the Samoan Meteorological Division and the Electric Power Corporation to develop a sustainable, operational system for the Afulilo Hydro-Electric Project.

More specifically, the project aims to:

- Build capacity in the Samoan Meteorological Division so they can provide customised climate forecasts to the, Electric Power Corporation.
- Strengthen relationships between the Samoan Meteorological Division and energy providers.
- Improve the hydrological model precision and reduce the error and bias associated with the modelled dam volumes.
- Use the data from the sensitivity tests to inform the development of a climate risk management plan.

Progress so far

Several outcomes have already been achieved:

- Preliminary analysis showed a significant correlation between seasonal storage volume and ENSO, with El Niño tending to coincide with lower storage volumes and La Niña tending to coincide with higher storage volumes.
- Installation of a new water height gauge at the dam wall.
- Relocation of the local rainfall gauge to an area unobstructed by foliage cover, improving the Electric Power Corporation's data collection capacity.
- A water balance model was derived and validated using climate, streamflow, power production and dam level data
- The validated water balance model and extended climate data was used to perform long-term sensitivity tests for parameters including power demand, dam storage capacity and seasonal rainfall variability.
- The Samoan Meteorological Division reported on their ability to supply the Electric Power Corporation with customised climate outlooks whilst the Electric Power Corporation had also begun supplying hydrology data to the Samoan Meteorological Division at irregular intervals indicating a growing operational relationship between the two agencies.

How this project is contributing the Global Framework for Climate Services in the Pacific

This pilot project has contributed to the GFCS by:

- Enhancing the capacity of the Samoan Meteorological Division to produce customised climate forecasts for the energy sector.
- Facilitating the exchange of data and expertise between the Samoan Meteorological Division and Electric Power Corporation.
- Working towards the implementation of an operational system in a developing country.

Afulilo Hydro-Electric Project

Australian Government AusAID Bureau of Meteorology

Climate and Oceans Support Program in the Pacific

Capacity Mapping

Stakeholder workshops

In-country Training

Climate Data Back-up