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Relationship between El Nino-Southern Oscillation and the incidence of malaria in the Solomon Islands

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Pacific Islands – Climate Prediction Project (PI-CPP)

www.bom.gov.au/climate/pi-cpp/

- Develop a software called SCOPIC (Seasonal Climate Outlook for Pacific Island Countries) to provide local NMS with the ability to issue seasonal climate forecasts specific to their country
- Training in SCF and Risk Management
- Conduct pilot project on the impact of climate on vulnerable sectors in each participating country

Decision support software providing seasonal climate outlooks for climate-sensitive industries in the Pacific Island Countries.

www.bom.gov.au/climate/pi-cpp

Developed the Smart State

version 1

scopic

helping communities in the Cook Islands, Fiji, Kiribati, Niue, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu.

SCOPIC (Seasonal Climate Outlooks for Pacific Island Countries) has been developed as part of the AusAID-funded project "Enhanced Application of Climate Productions in Pacific Island Countries". The aim of this project is to enable Pacific Island National Meteorological Services to provide timely seasonal prediction services to people in climate sensitive industries. The project is implemented in the Cook Islands, Fiji, Kiribati, Niue, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

Exploration
Highly graphical time-series and statistical analyses show exploration of sea-level rise, sea surface temperature, Southern Oscillation Index, and rainfall. Analyses include scatter-plots and monthly/seasonal summary statistics.

Prediction
SCOPIC uses rainfall distribution analysis algorithms to generate seasonal outlooks in tabular and/or bulwag report formats. Results are presented graphically in the form of "chocolate spreads", as well as in tabular and report formats.

Evaluation
Temporal and spatial evaluation of forecasting skill is available through advanced skill-score and "rank-sum" analysis. Skill can be assessed for different periods of the year and forecast lead-times. Individual "hindcast" results can be reviewed on a plot-by-plot basis.

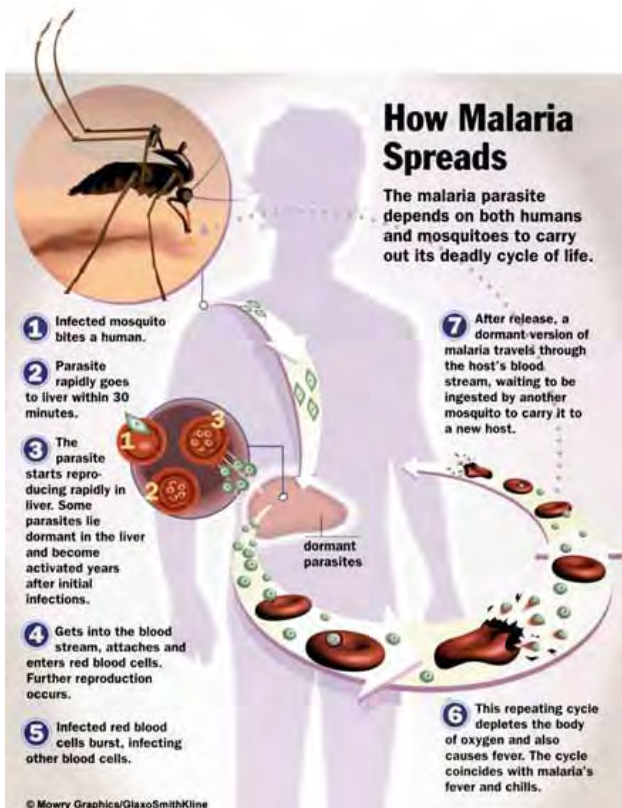
Reporting
Generate "rich-text" reports using pre-configured XSLT templates, customisable for each country. The reports provide a concise summary of the outlooks, and update automatically with program changes. The reports can then be edited, saved and printed.

"A collaborative project between the Queensland Climate Change Centre of Excellence and the Australian Bureau of Meteorology"

Australian Government
AusAID
Bureau of Meteorology

Queensland Government
Climate Change Centre of Excellence
Department of Natural Resources and Water

Prediction of Vector-born diseases (Malaria)



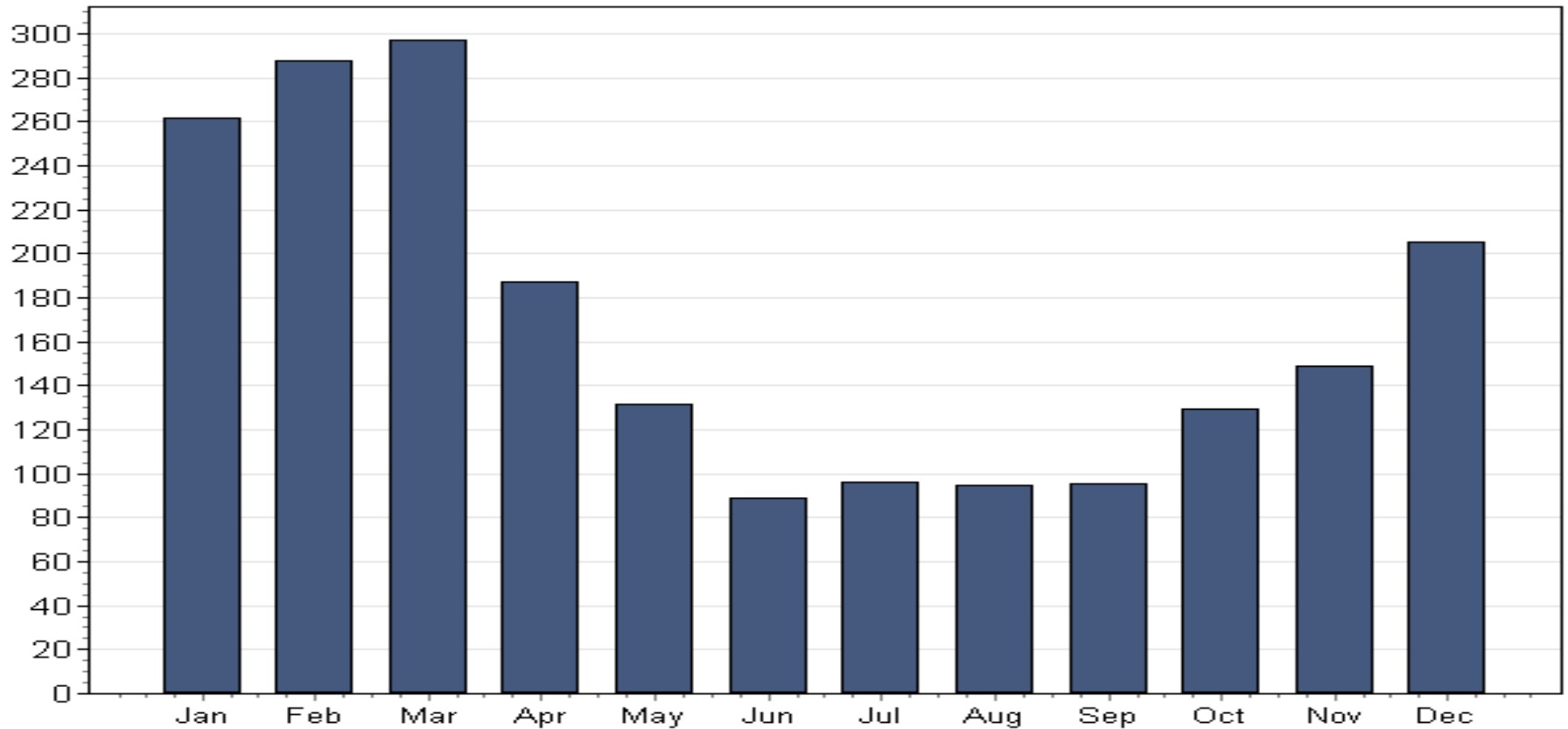
Aims

- Determine whether malaria epidemics in the Solomon Islands are related to the ENSO, rainfall and other hydro-climatic variables; and
- Determine if such relationship can be used as an early warning system for predicting heightened risk of a malarial epidemic and therefore in assisting targeted control strategies.



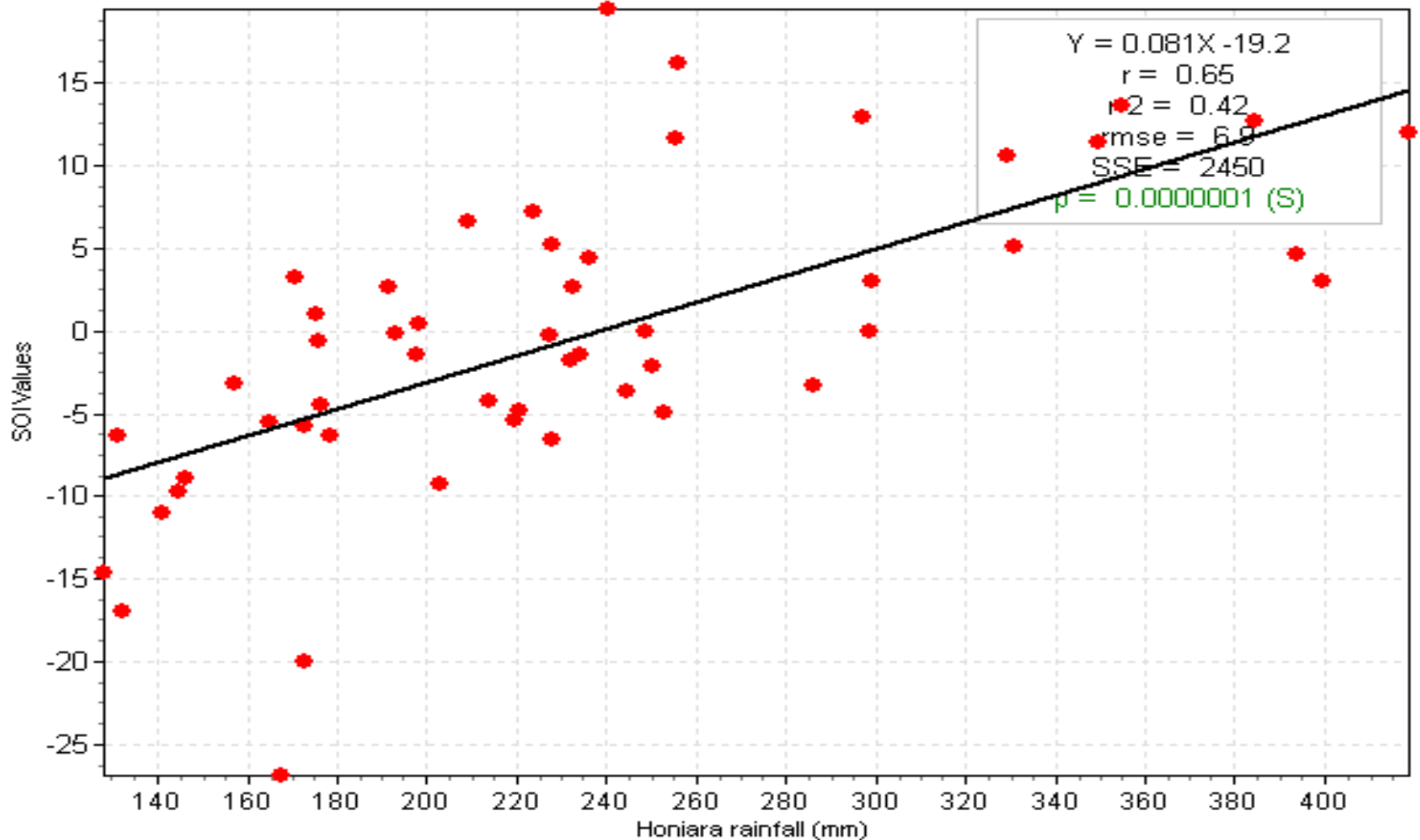
Climate of Solomon Islands

Monthly average values
Honiara rainfall (mm)



Concurrent relationship between SOI and Rainfall

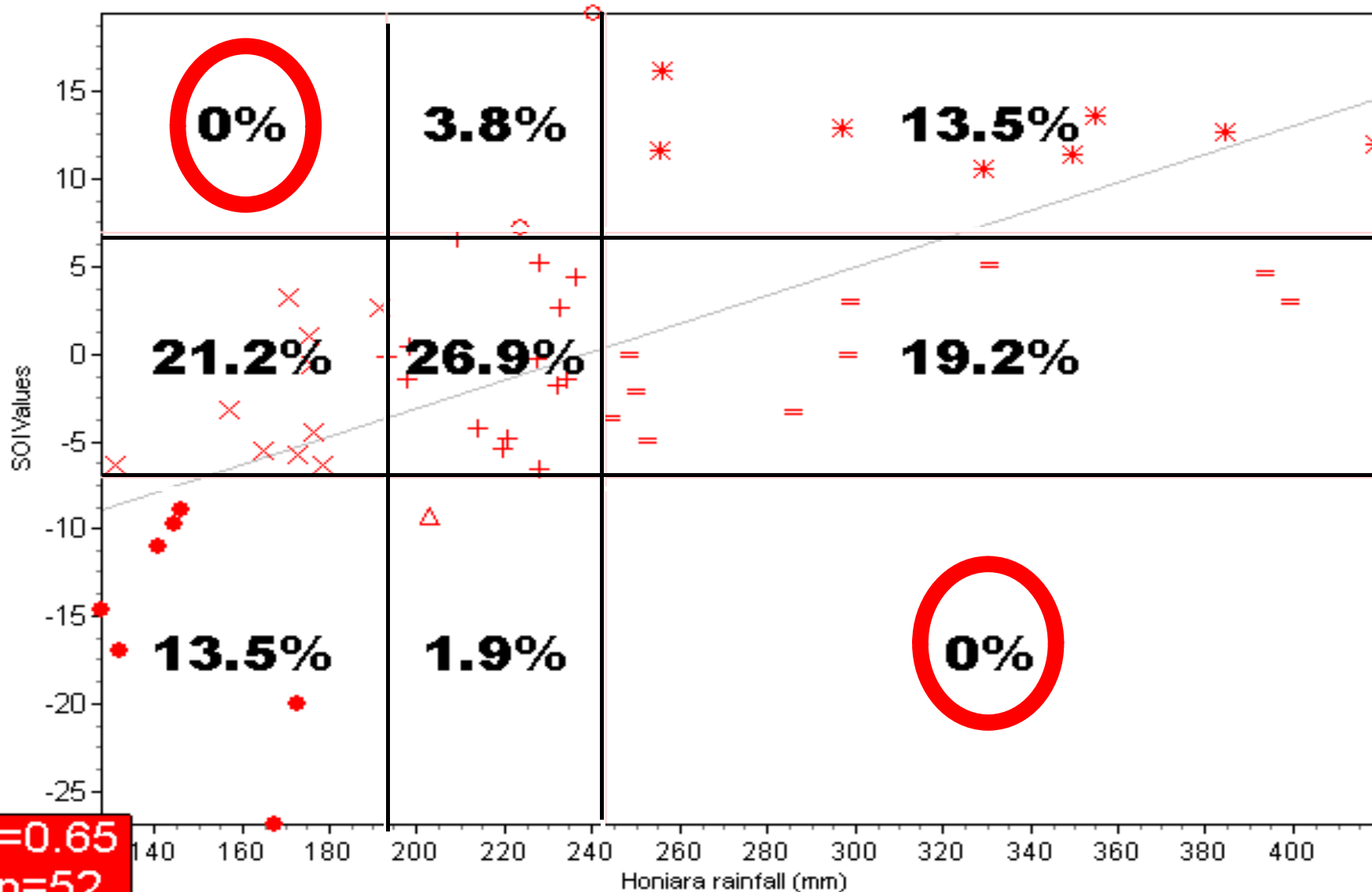
Nov-Apr Honiara rainfall (mm) vs SOI Values



Sampling regression analysis for Nov 2009-Apr 2010 Predictands (6mth Average) using 6mth avg SOI Values (Nov-Apr) (-6mths lead)

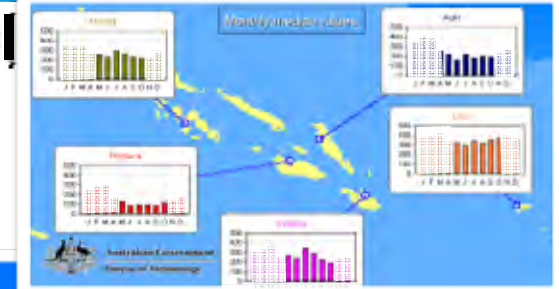


Nov-Apr Honiara rainfall (mm) vs SOI Values



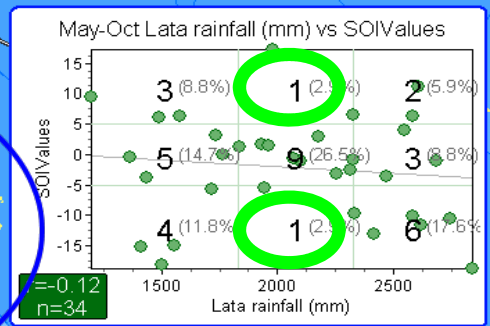
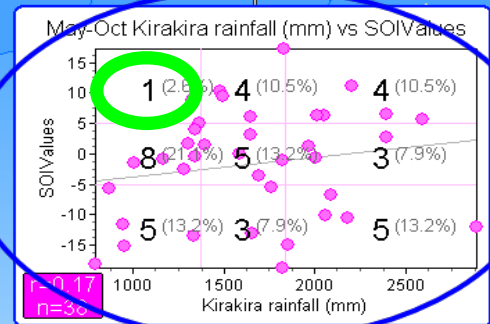
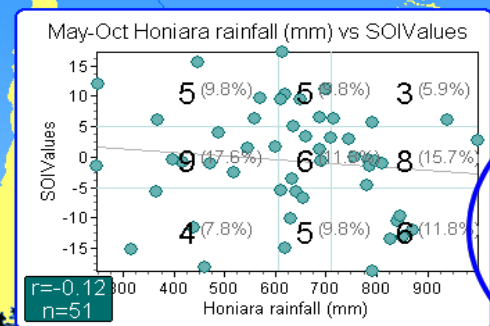
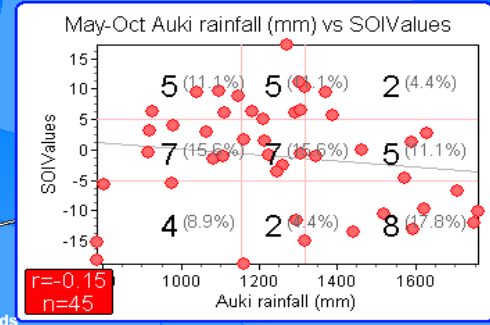
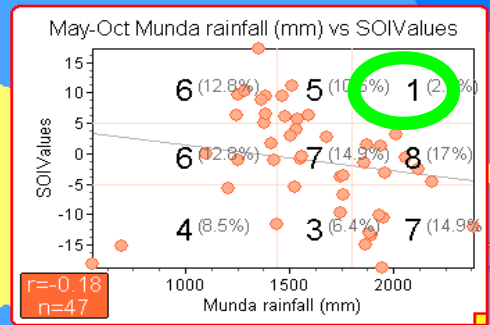
Solomon Islands

Capital: Honiara
 Area: 28,896 km² Population: 523,000



Concurrent relationship between rainfall and SOI (May – October)

Synchronous relationships between predictands and SOI Values for the May to Oct period



Fiji avg. r = 0.15

Ratings

May-Oct



Nov-Apr

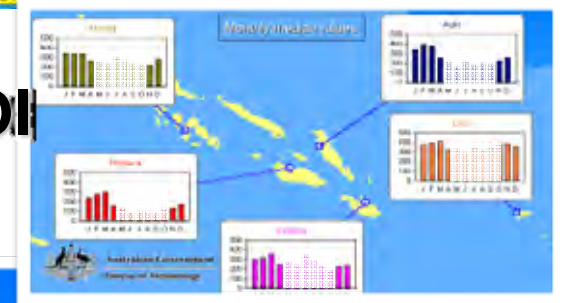


Solomon Islands

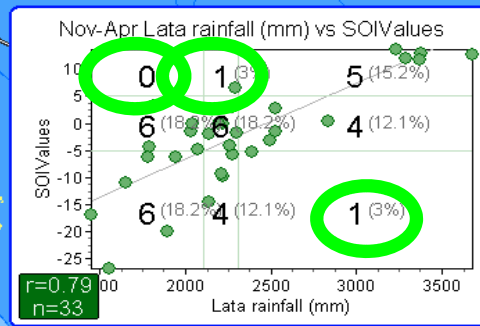
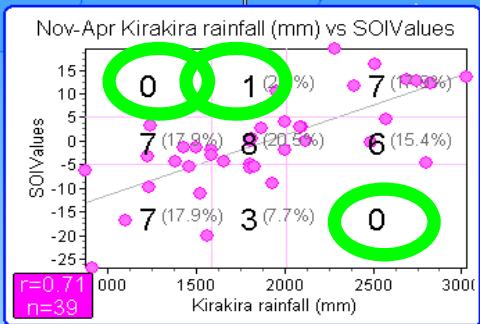
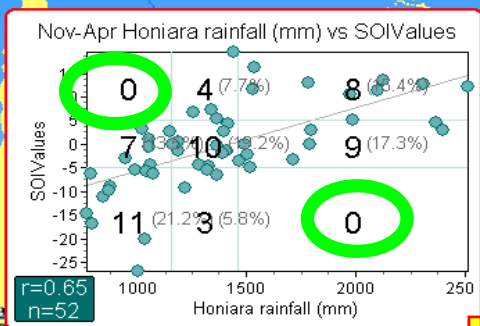
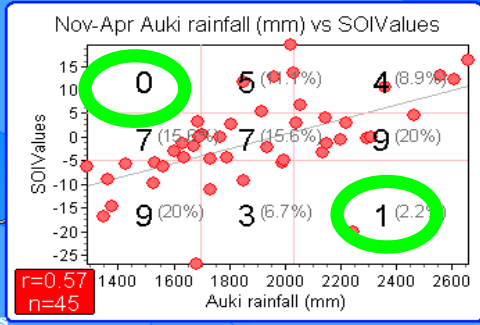
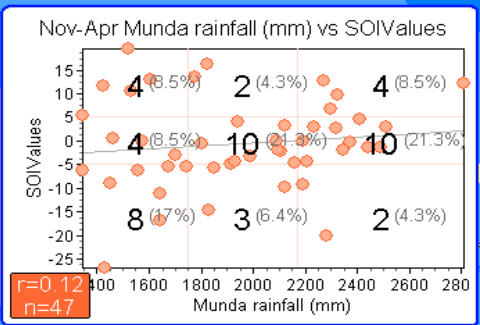
Capital: Honiara
 Area: 28,896 km² Population: 523,000



Concurrent relationship between rainfall and SOI (November - April)



Synchronous relationships between predictands and SOI Values for the Nov to Apr period



Fiji avg. r=0.57

Ratings

May-Oct



Nov-Apr

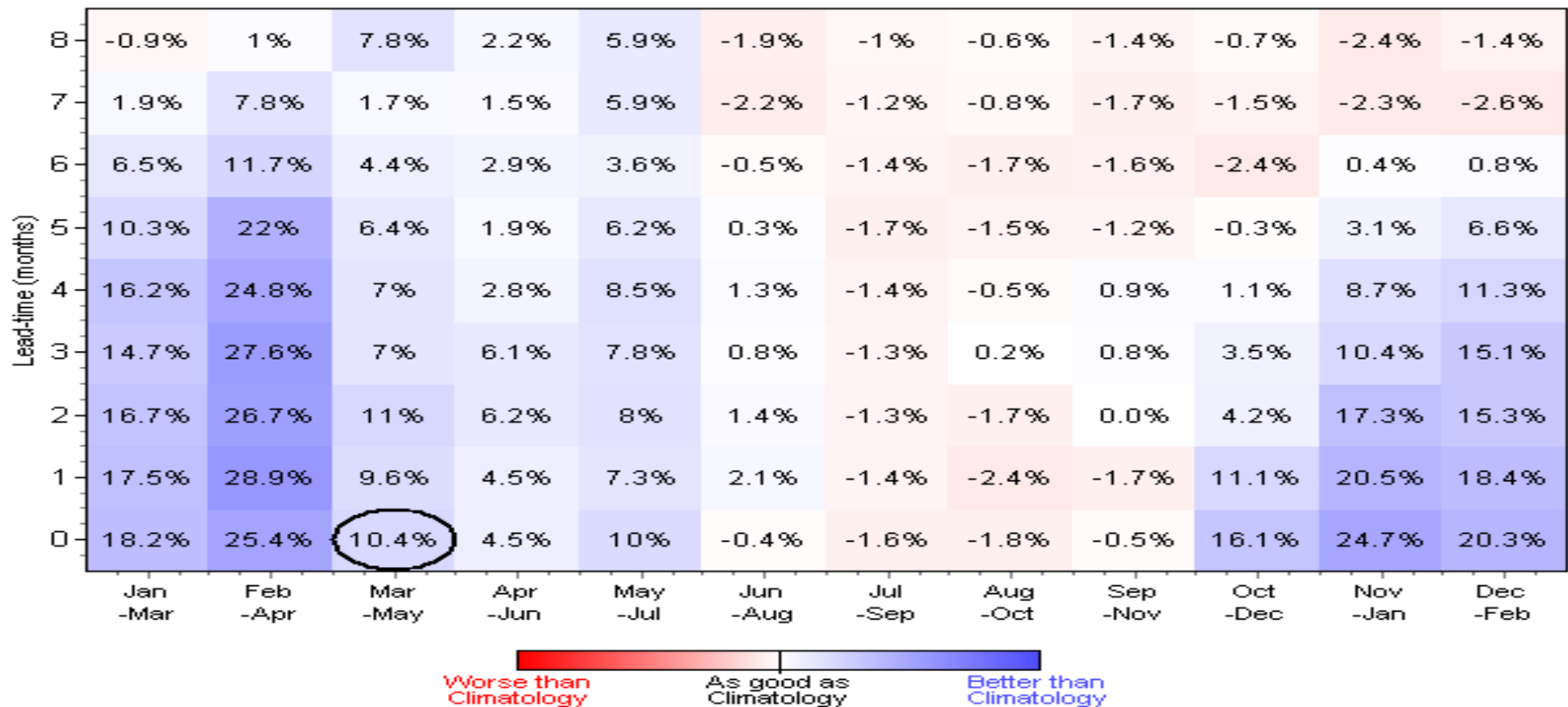


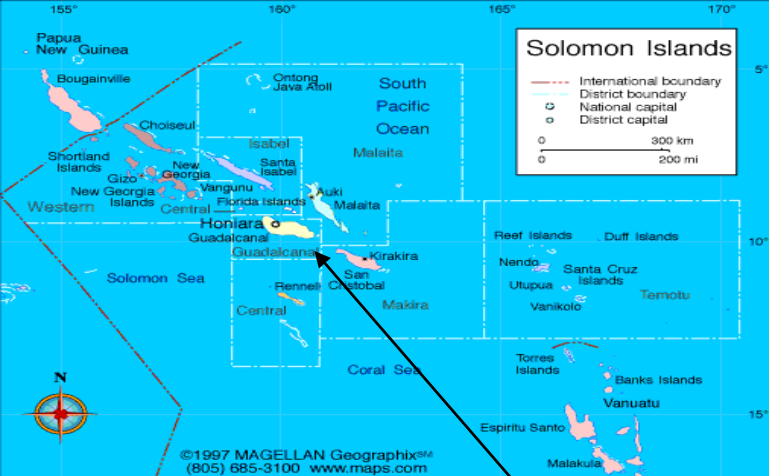
Rainfall Prediction Skill

Cross-validated Tercile LEPS Scores
3mth avg SOI Values



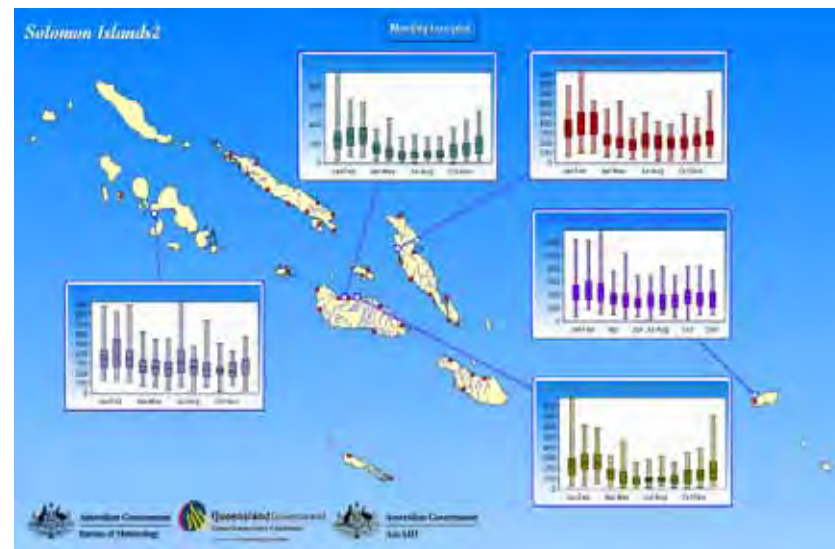
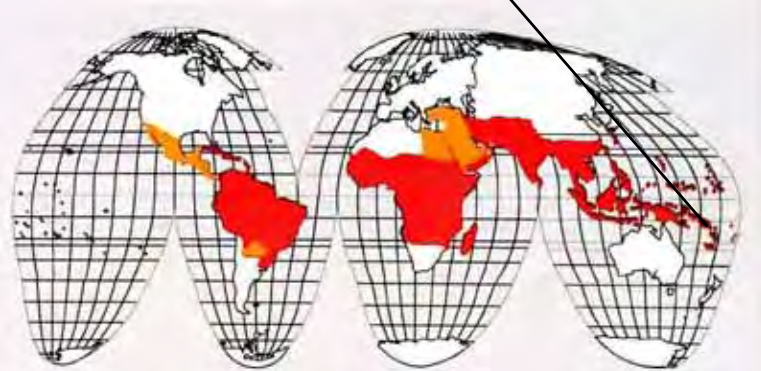
Honiara (51-55 Years)



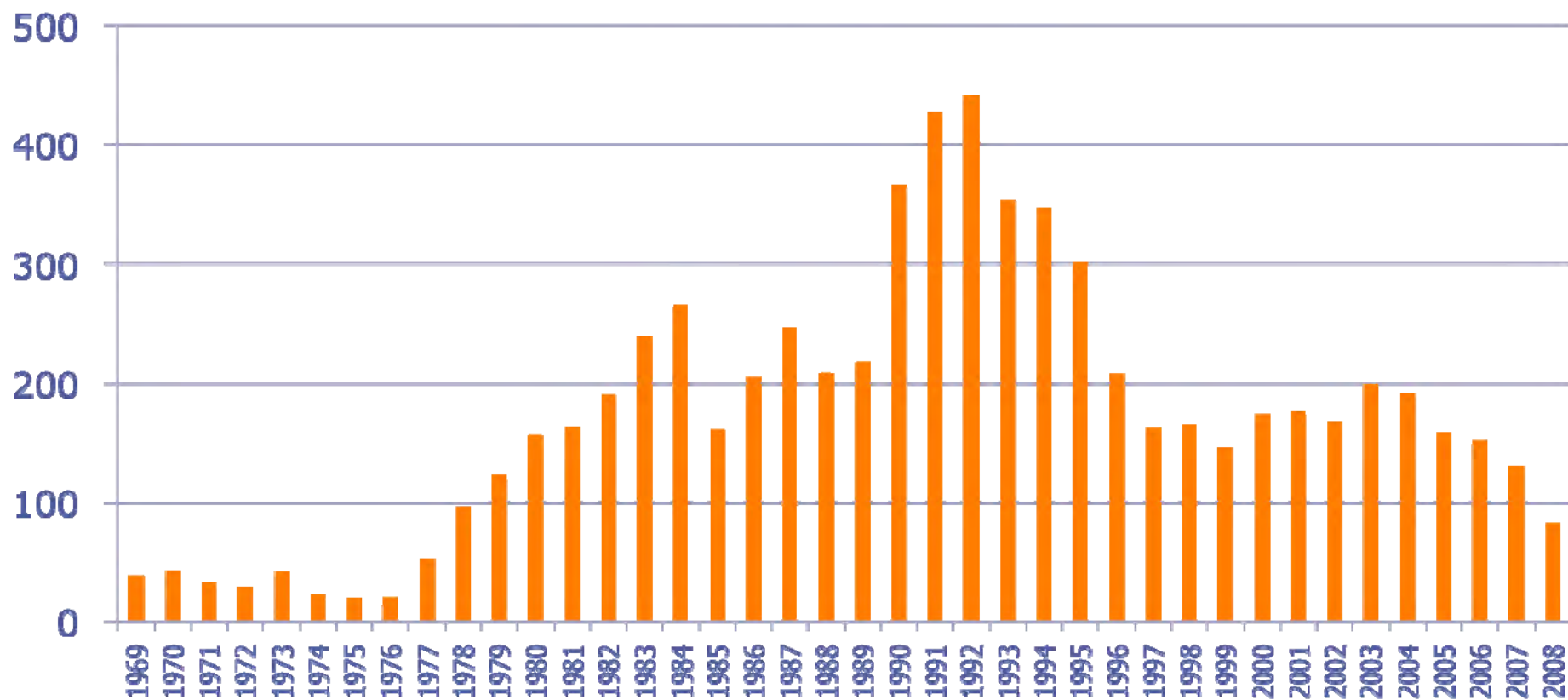


Malaria Snapshot

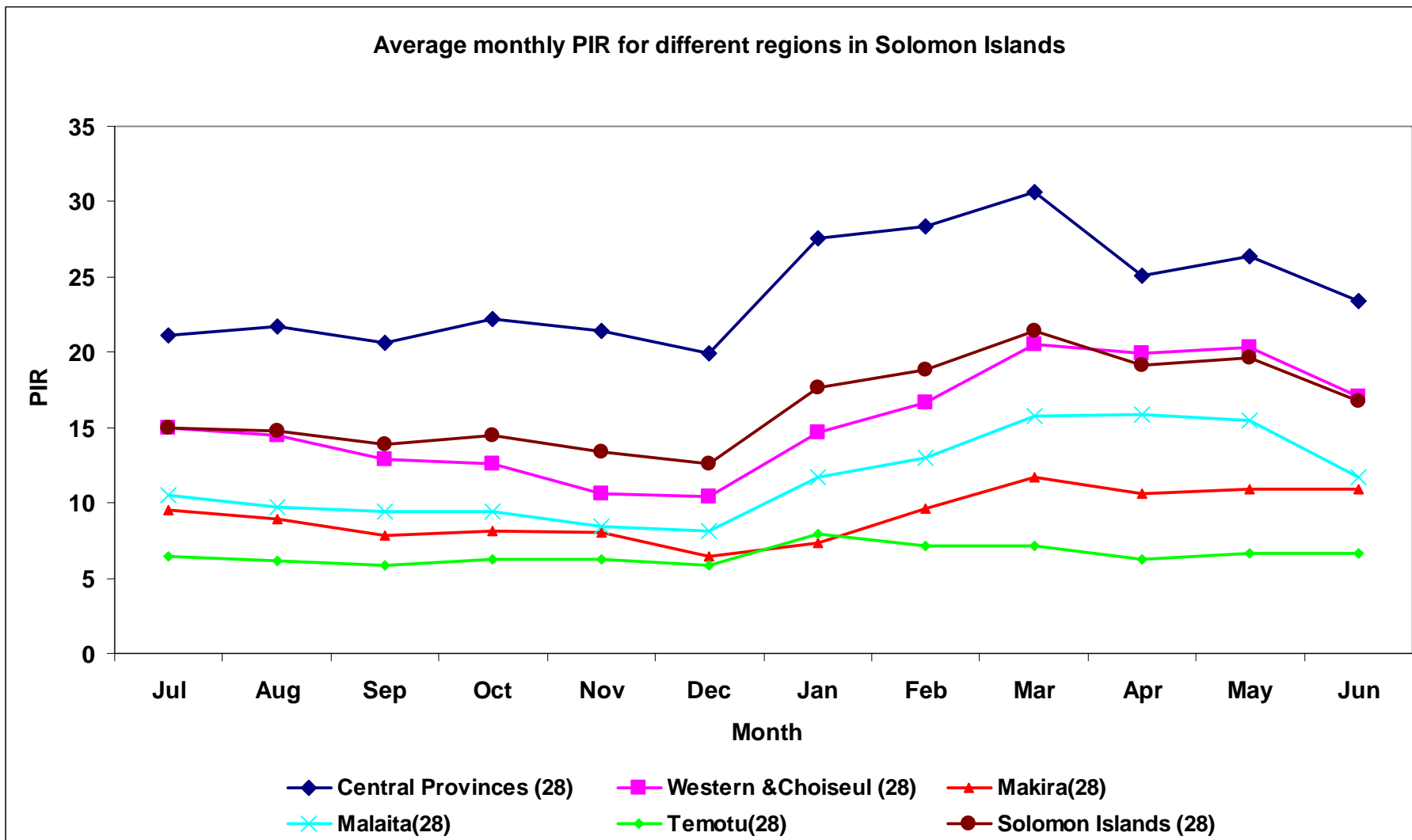
- 100 countries, 40% of world population live in areas where malaria transmission occurs
- 300 – 500 million cases each year world wide
- 750,000 – 2 million deaths each year
- *Plasmodium falciparum* accounts for 60-70% of all cases in SI. Transmitted by Anopheles Mosquitoes
- Ideal breeding condition (25-30 C, RH 60%)



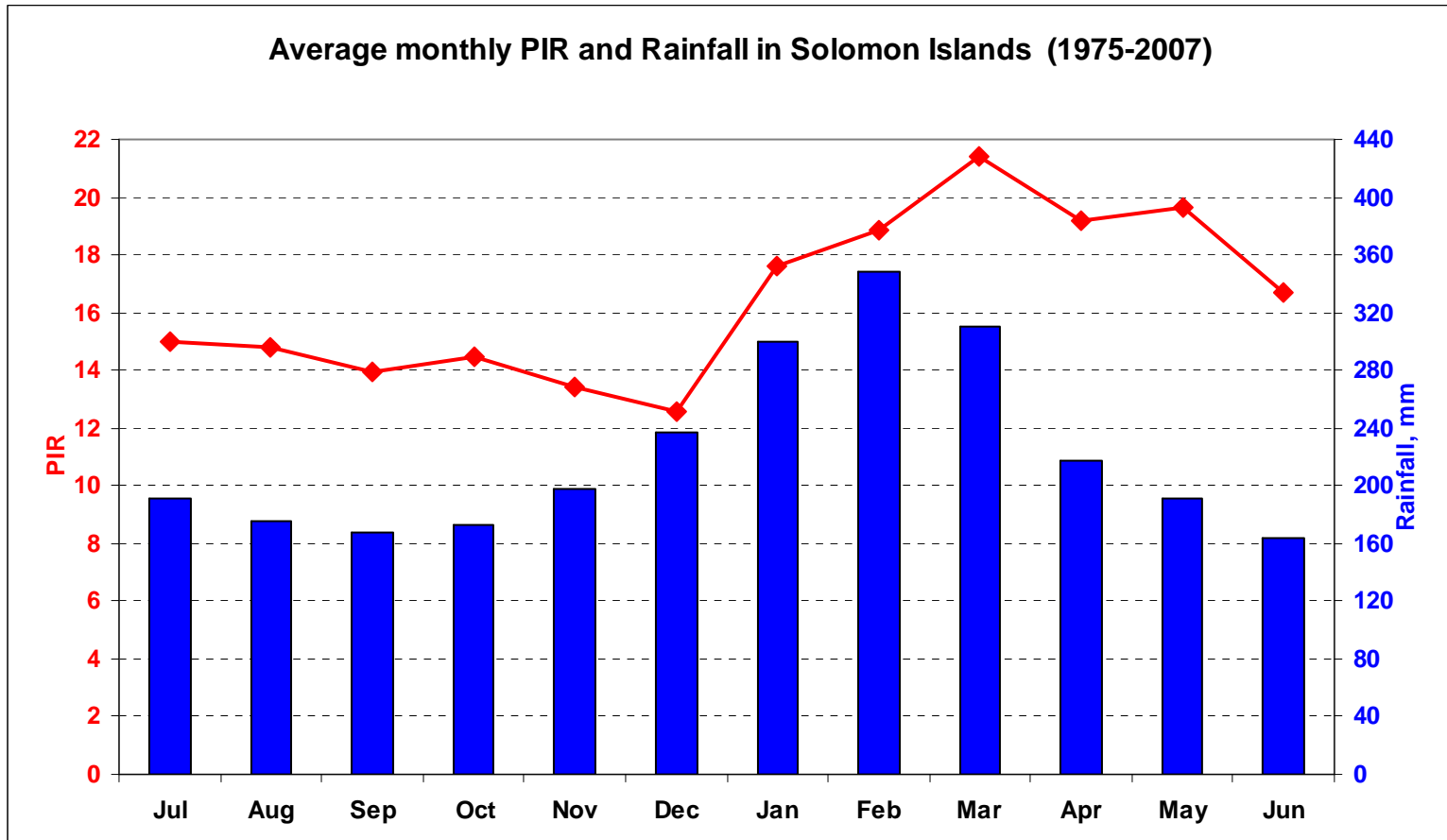
Annual incidence of slide confirmed malaria since 1969 in Solomon Islands



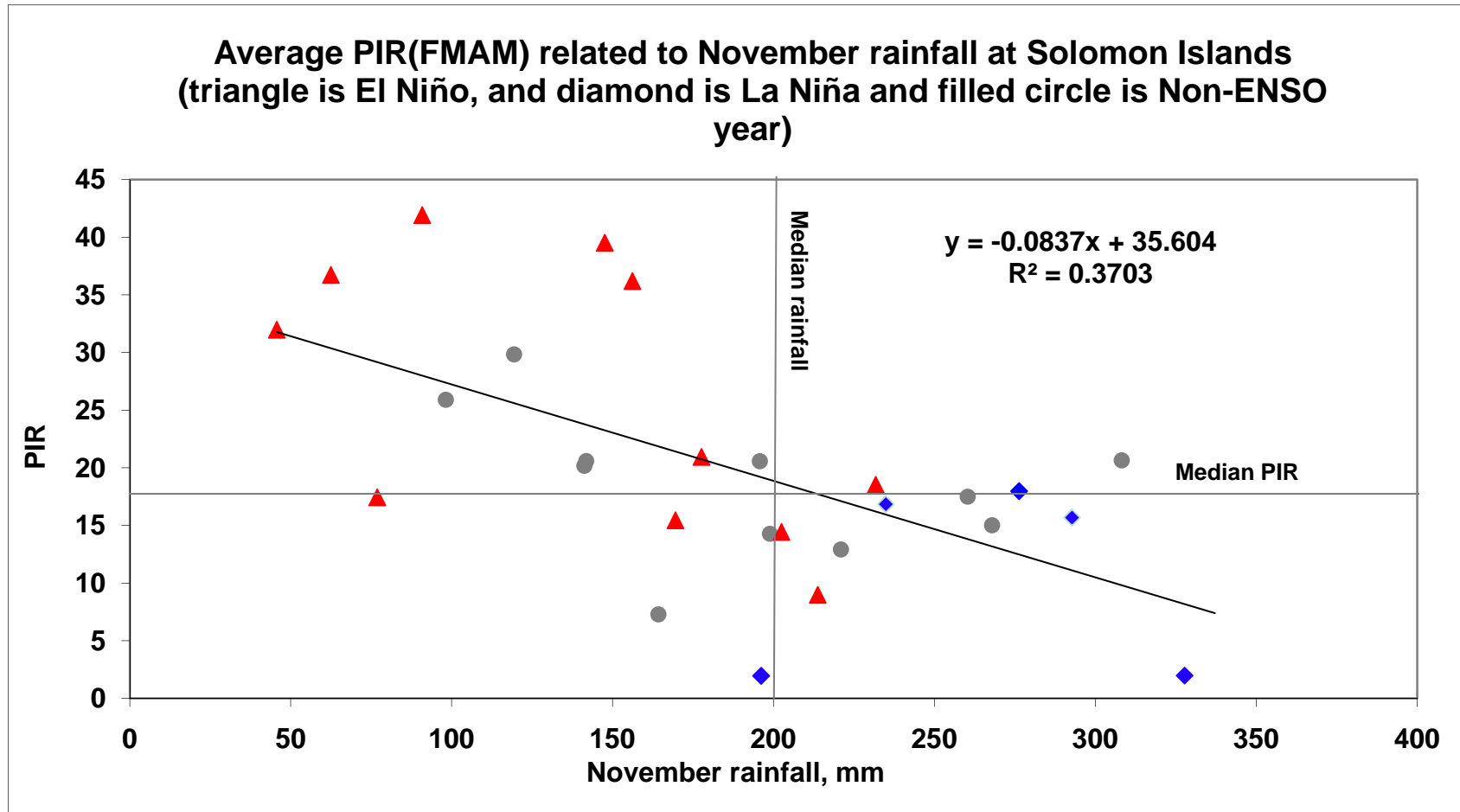
Average monthly malaria PIR distributions for different regions in Solomon Islands



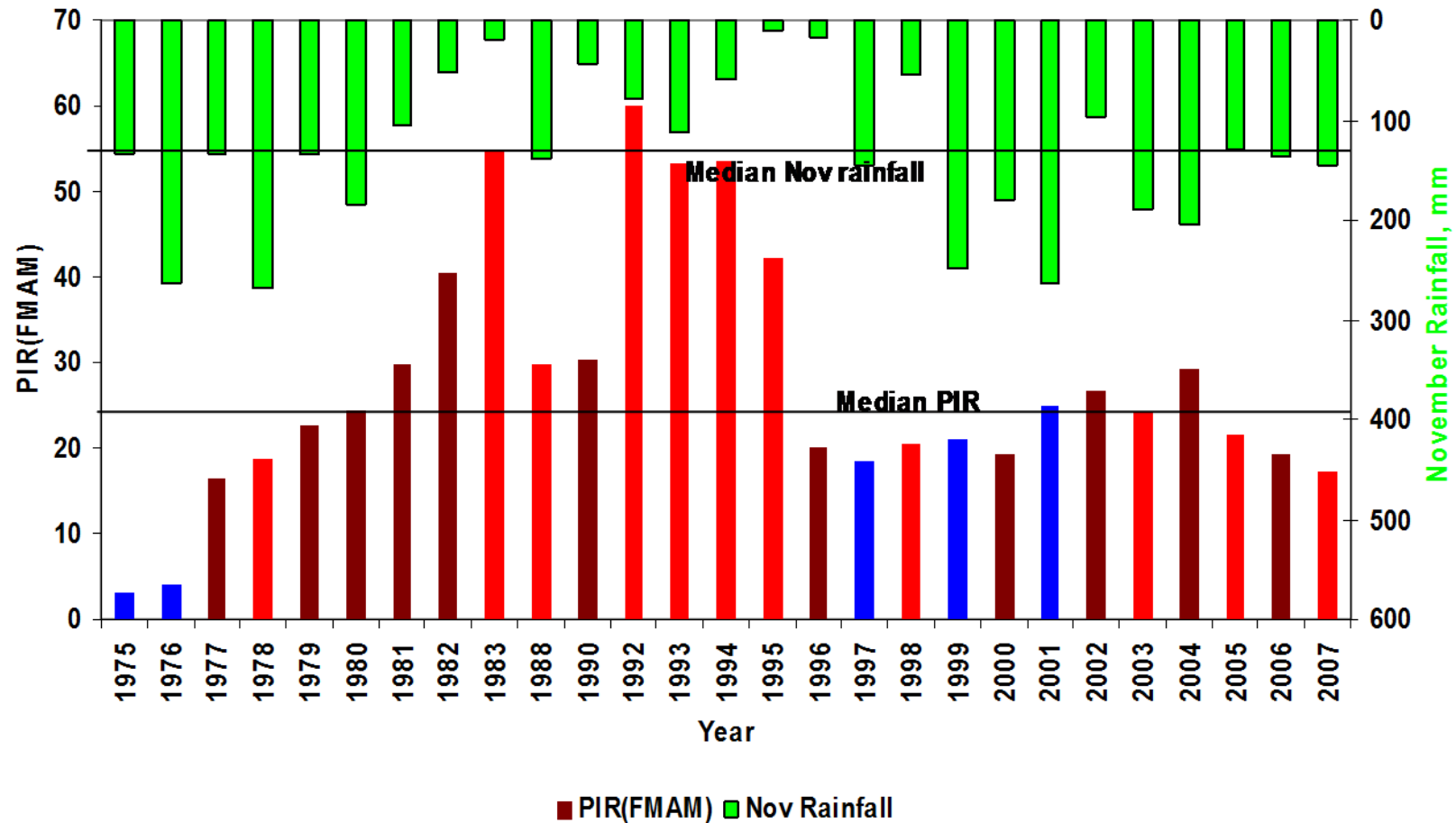
Positive Incidence Ratio (PIR) per 1000 population



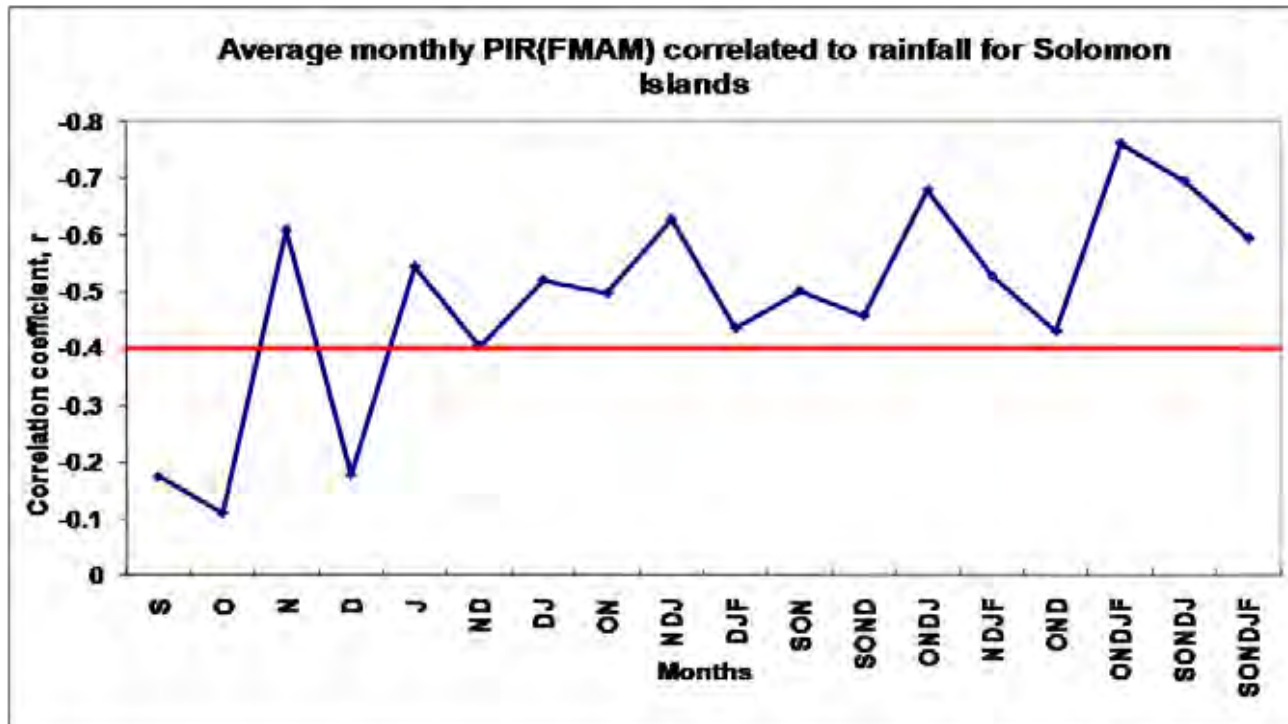
Average PIR (FMAM) vs November rainfall



**Distribution of PIR(FMAM) according to rainfall in November of the previous year
(red bar indicates El Nino and blue bar indicates La Nina years)**

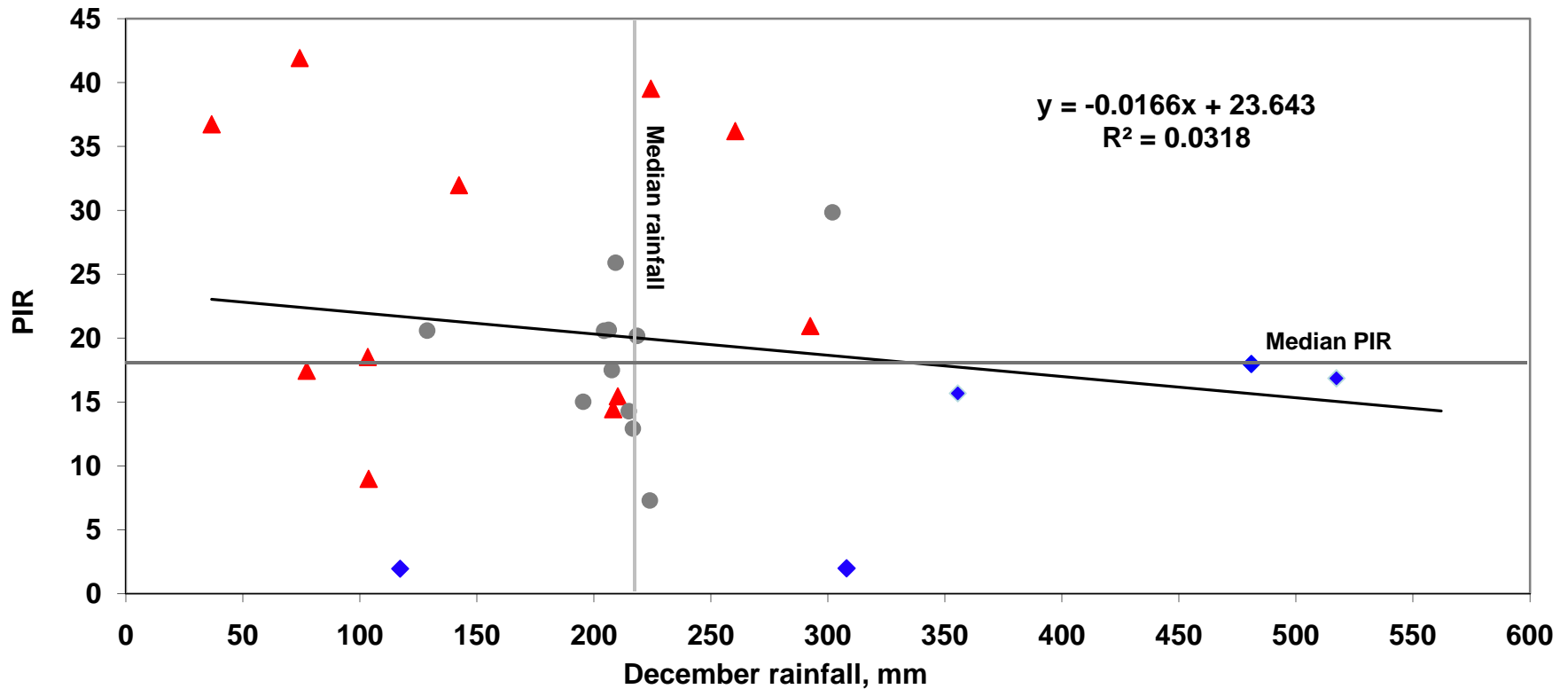


Average monthly PIR (FMAM) related to average monthly rainfall from September through to February

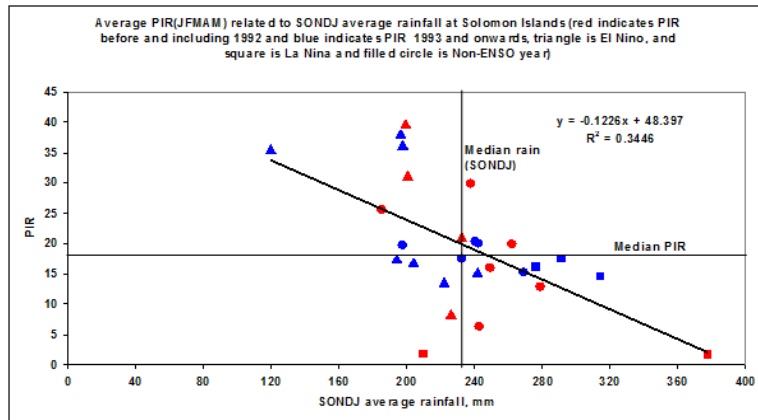


Average PIR (FMAM) vs December rainfall

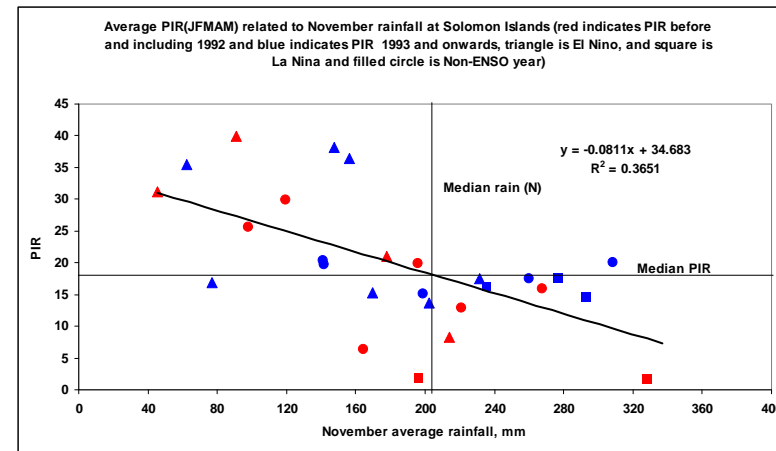
Average PIR(FMAM) related to December rainfall at Solomon Islands (triangle is El Niño, and diamond is La Niña and filled circle is Non-ENSO year)



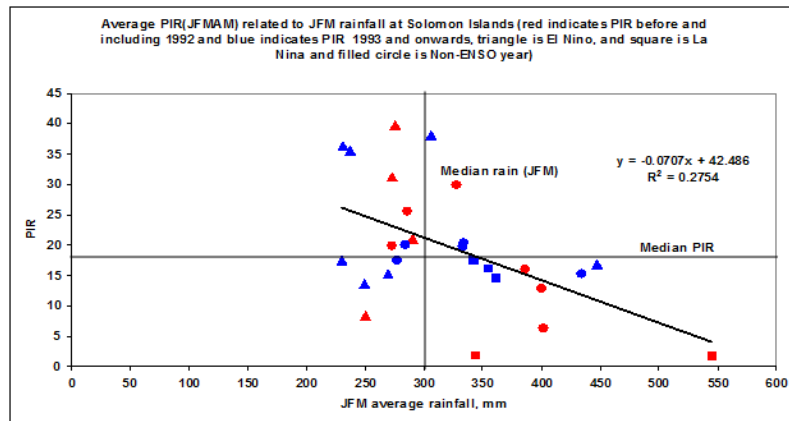
Average PIR(JFMAM) vs rainfall in SONDJ



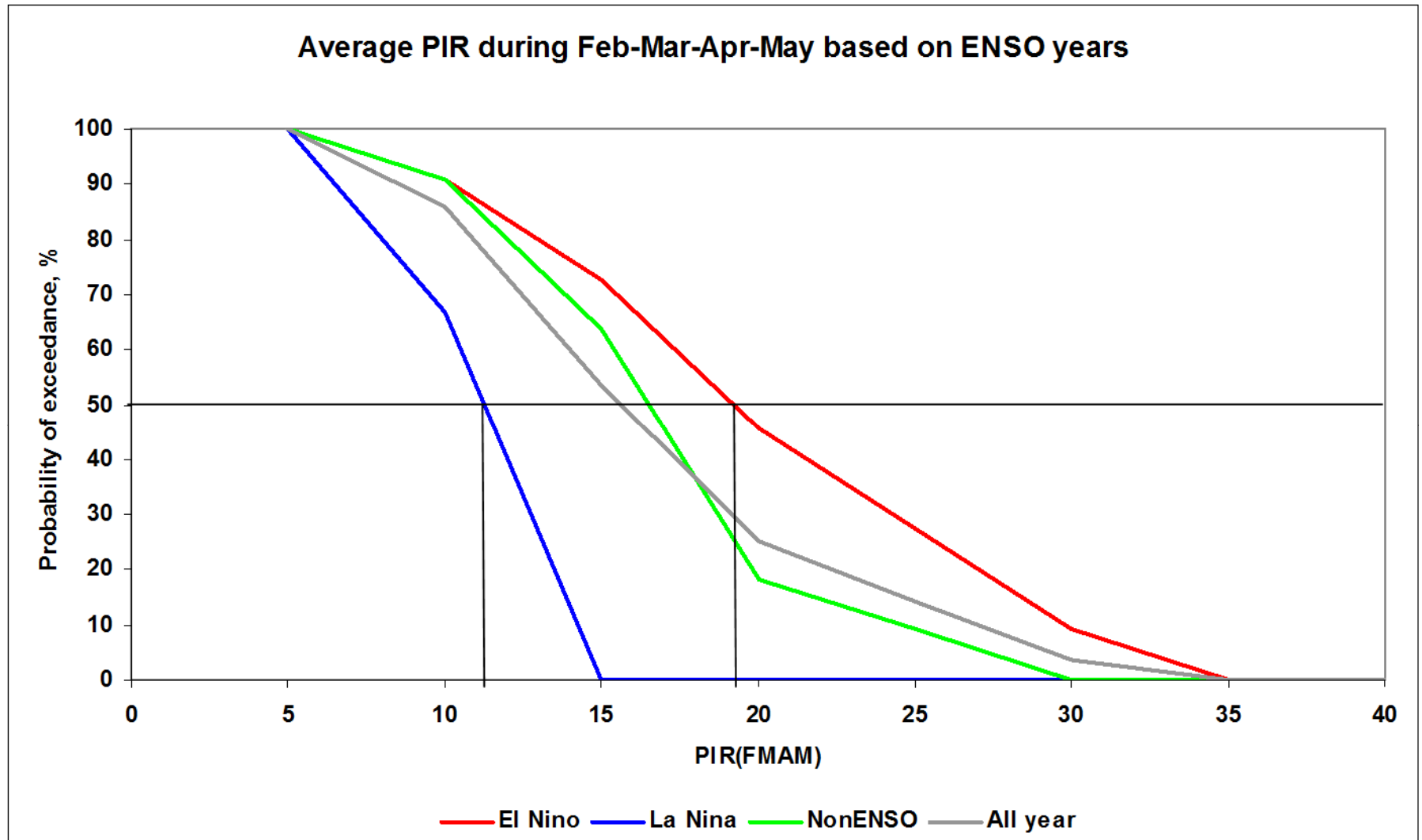
Average PIR(JFMAM) vs rainfall in September



Average PIR(JFMAM) vs rainfall in JFM



PIR(FMAM) distribution in Makira region based on ENSO years



Mosquito life cycle is affected by temperature

Table 1: The effect of mean temperature on the duration of mosquito's life cycle and sporogonic cycle and its effect on the amount of lead time from the availability of breeding sites to the occurrence of malaria cases.

Weather factors	Stages and duration of mosquito's life cycle and sporogony cycle affected by weather factors		
Mean temperature (Rainfall temperature)	Availability of breeding sites -----> Malaria		
	Mosquito's life cycle*	Sporogony†	Incubation period in human host
	Larva -----> Adult(days)	Adult first bite -----> Infectious bite (days)	
16°C	47	111	(10-16 days)
17°C	37	56	
18°C	31	28	
20°C	23	19	
22°C	18	7.9	
30°C	10	5.8	
35°C	7.9	4.8	
39°C	6.7	4.8	
40°C	6.5	4.8	

Rueda LM, Patel KJ, Axtell RC, Stinner RE: **Temperature-dependent development and survival rates of *Culex quinquefasciatus* and *Aedes aegypti* (Diptera: Culicidae).** *J Med Entomol* 1990, **27**:892-898.

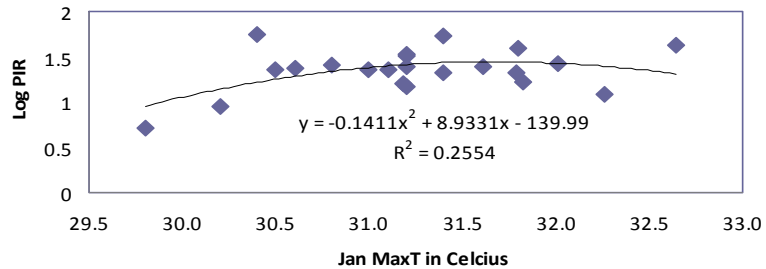
MacDonald G: **The epidemiology and control of malaria.** London: Oxford University Press; 1957.

le Sueur D BLS: **Temperature dependent variation in *Anopheles Merus* larval head capsule width and adult wing length: implications for anopheline taxonomy.** *Med Vet Entomol* 1991:55-62.

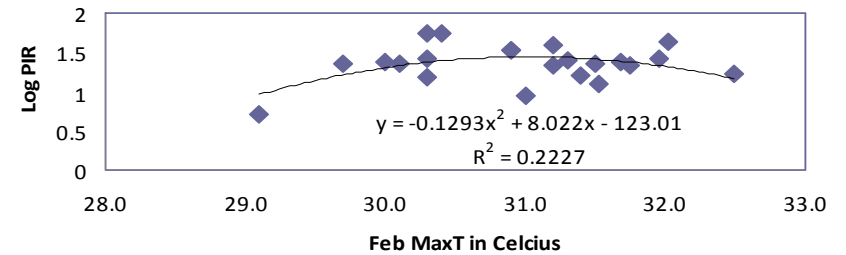
Detinova TS: **Age-grouping methods in Diptera of medical importance, with special reference to some vectors of malaria.** *Monogr Ser World Health Organ* 1962, **47**:13-191.

PIR and Maximum Temperature

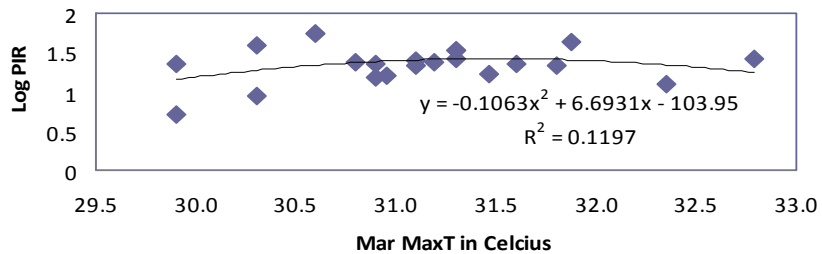
LogPIR (DJFM) distribution against Jan MaxT in Guadalcanal



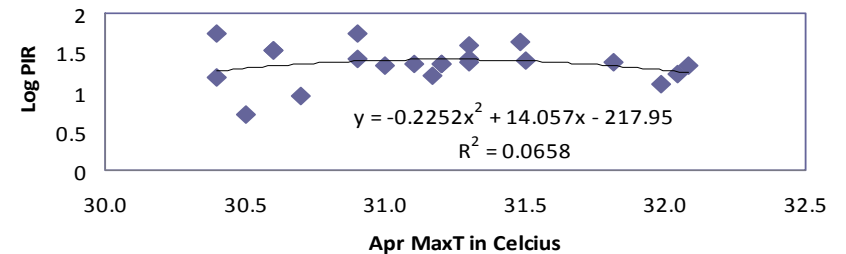
LogPIR (DJFM) distribution against Feb MaxT in Guadalcanal



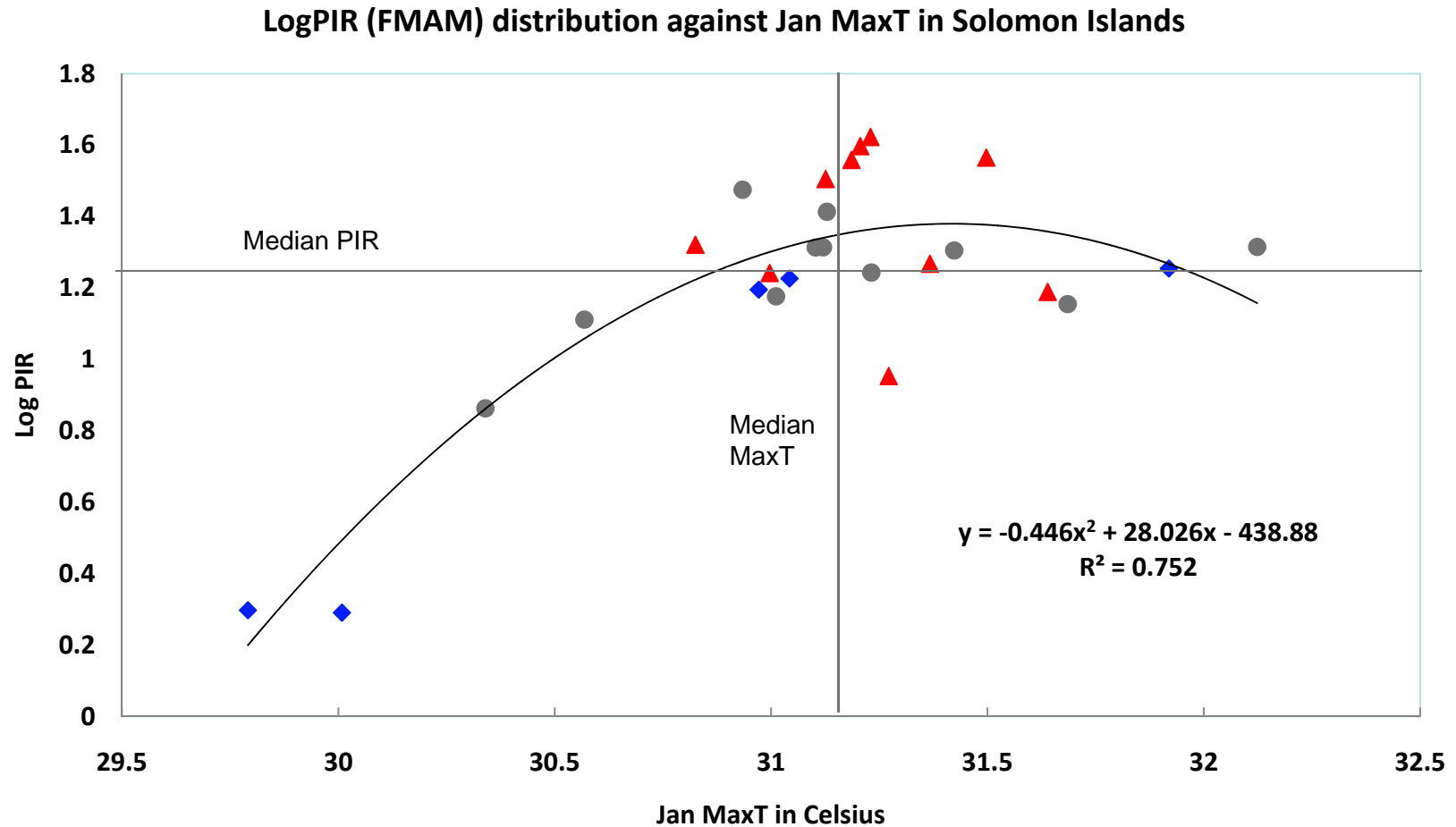
LogPIR (DJFM) distribution against Mar MaxT in Guadalcanal



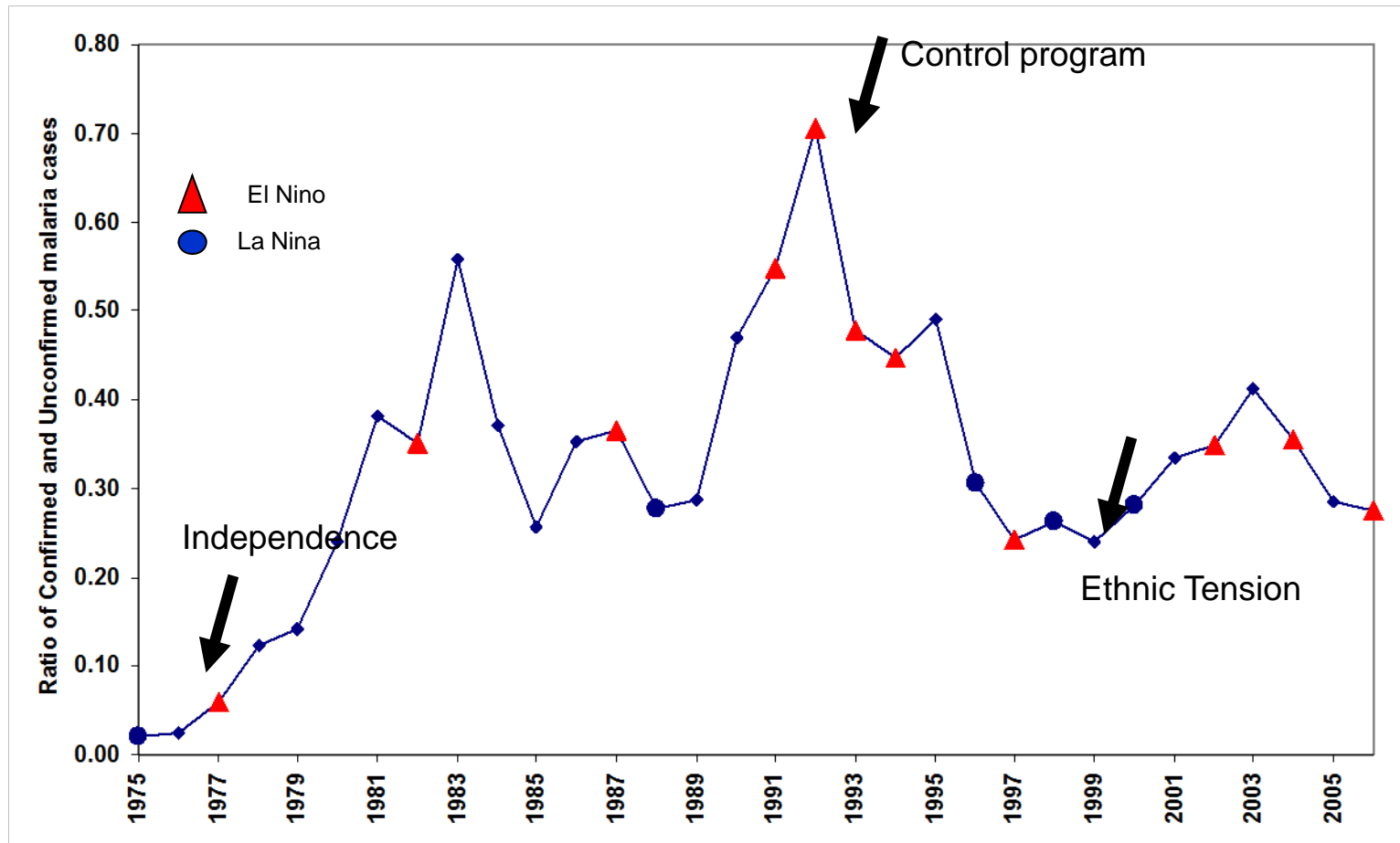
LogPIR (DJFM) distribution against Apr MaxT in Guadalcanal



PIR (FMAM) distribution of malaria as a function of maximum temperature in January in Solomon Islands (Triangle indicates El Niño, Diamond is La Niña and the rest are Non-ENSO years)



Confirmed to unconfirmed malaria cases in the Solomon islands (1975-2006)



Non-climatic and climate related inter-annual variability in annual confirmed malarial incidence for Solomon Islands for 1975-2006

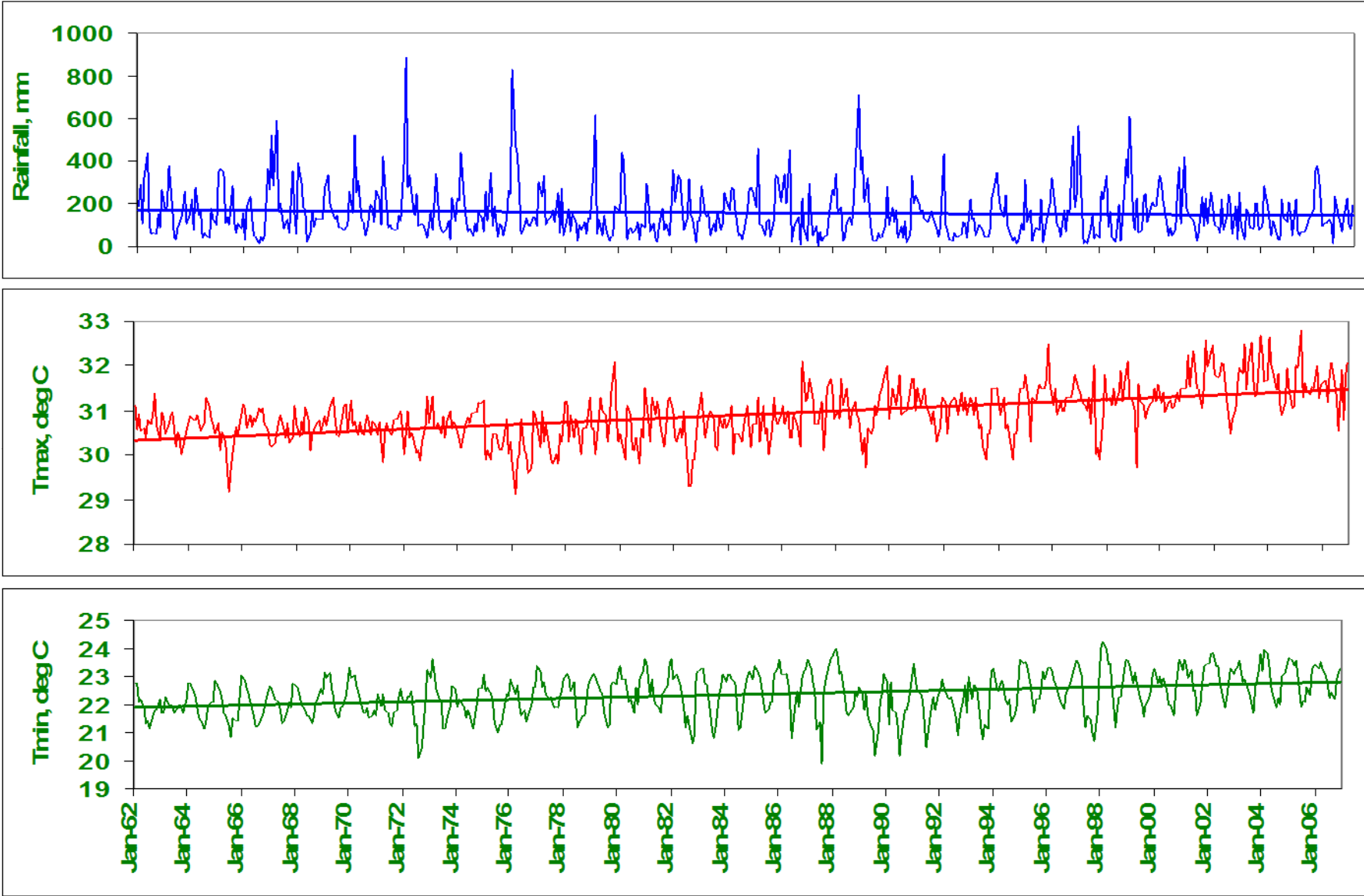
Model	Multiple r	r²	Adjusted r²	Standard Error
1	0.61	0.37	0.35	0.26
2	0.66	0.44	0.40	0.24
3	0.88	0.78	0.74	0.16

Model 1: JFM average monthly rainfall

Model 2: Model 1 and JFM temperature

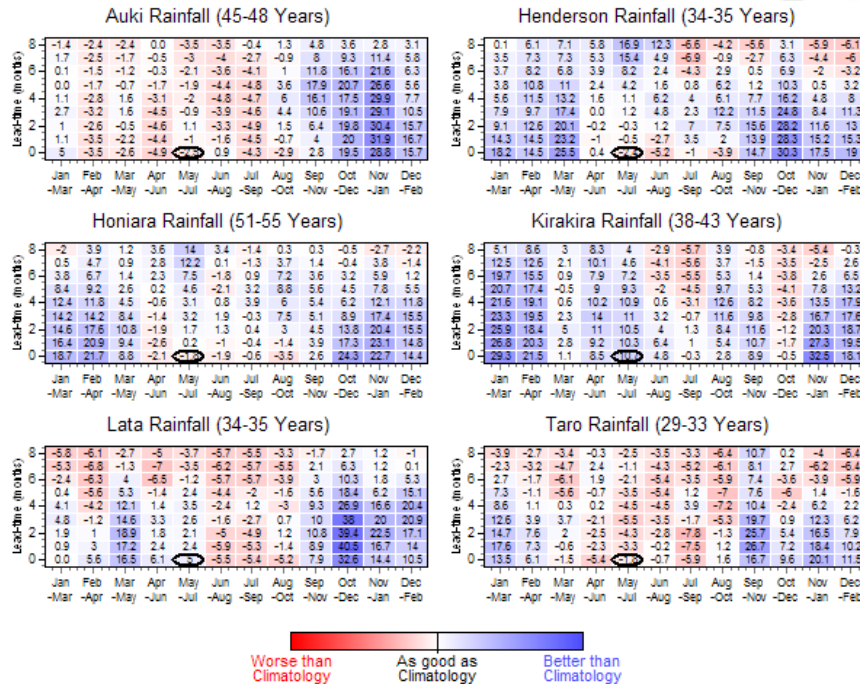
Model 3: Model 2 and Policy Intervention

Rainfall, Maximum and Minimum Temperature (Honiara)



Predictability of rainfall in Solomon

Cross-validated Tercile LEPS Scores
3mth avg SST's 1 and 9



Rainfall prediction based on SST 1 and 9 have good skill during the wet season for most of the provinces except Western and Choiseul. It is therefore possible to forecast malaria epidemic well ahead of time and take preventative measure to reduce its impact on the population

Continued support is essential for successful adoption

2 **Solomon Star** (Saturday 1 August, 2009) www.southislandnews.com

★LOCAL NEWS

Local activist urges NZ, Aust to reduce emissions

By Jim Milla

A LOCAL environmentalist has urged Australia and New Zealand to help reduce greenhouse gas emissions to slow global warming.

Mr. Milla said the world is warming up and the effects will be felt in the Pacific. He said that the world is warming up and the effects will be felt in the Pacific. He said that the world is warming up and the effects will be felt in the Pacific.

PM to report to Forum on RAMSI partnership

PRIME MINISTER Sir Frank Robinson will report to the Pacific Islands Forum on the partnership between RAMSI and the Solomon Islands.

Rarasu Motel assists local church

MANAGING DIRECTOR of Rarasu Motel, Jackson Paitani, right, and his wife Mary Paitani, middle, handing over the cheque for \$10,000 to members of the church.



MANAGING DIRECTOR of Rarasu Motel, Jackson Paitani, right, and his wife Mary Paitani, middle, handing over the cheque for \$10,000 to members of the church.

Today's weather

General Forecast: A cloudy to overcast day with a chance of rain in the south of the island.

Climate forecasting can help predict malaria outbreaks

Climate forecasting can help predict malaria outbreaks. The relationship between the incidence of malaria and climatic conditions is currently being investigated as part of the Pacific Islands Climate Prediction Project (PI-CPP), which is funded by AusAid and administered by the Australian Bureau of Meteorology in collaboration with the Solomon Islands National Health Research and Training Institute. This study has shown that malarial incidence peaks during the January to May period, coinciding with the rainy season in the Solomon Islands. Since an El Niño is currently affecting the Solomon Islands, rainfall in this period is likely to be reduced and temperatures increased across most of the Solomon Islands in coming months. Increased temperatures will result in a shorter breeding cycle for mosquitoes and lower rainfall will reduce the flushing of larvae from stagnant water. These factors are likely to contribute to increased mosquito numbers and a higher rate of malaria transmission occurring this summer in the Solomon Islands. Authorities are reminding residents to be diligent in taking preventative measures such as use of bed nets, especially during the early morning and evening, and where possible remove potential breeding sites such as stagnant pools of water where mosquitoes can harbour. If you have any malarial symptoms such as high fever, please report to your local medical officer.

Contact: Mr Lloyd Tahani, National Meteorological Services, Solomon Islands.

Higher incidence of malaria forecast for this summer

A mature El Niño condition is continuing to dominate in the equatorial Pacific Ocean. In the Solomon Islands, El Niño is usually associated with higher temperatures and less rainfall than the long-term average. These conditions are conducive to a heightened risk of malarial infections for the Solomon Islands during the peak infection period of January to May.

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**Media Release
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