Australian Government
AusAID
Bureau of Meteorology





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

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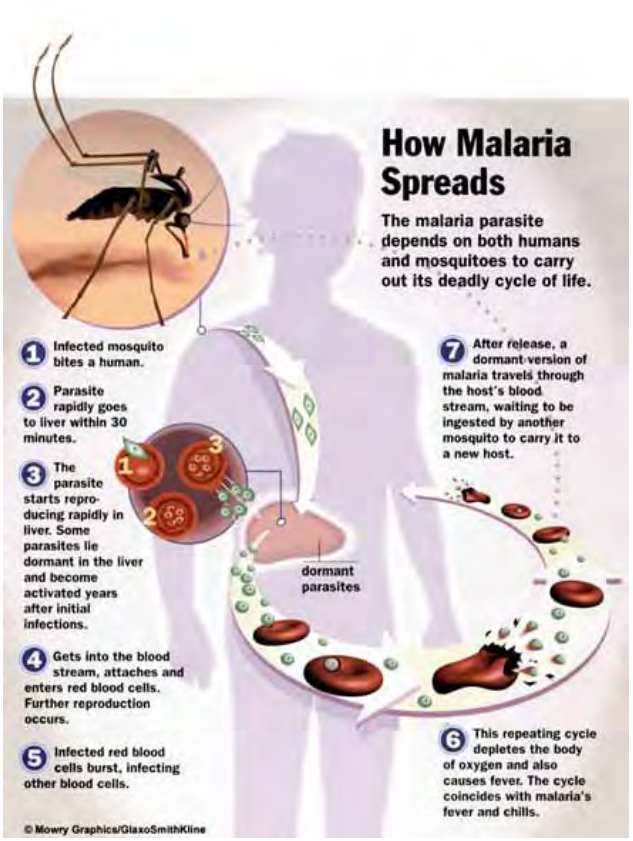
Pacific Islands – Climate Prediction Project (PI-CPP)

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**

Pacific Islands – Climate Prediction Project

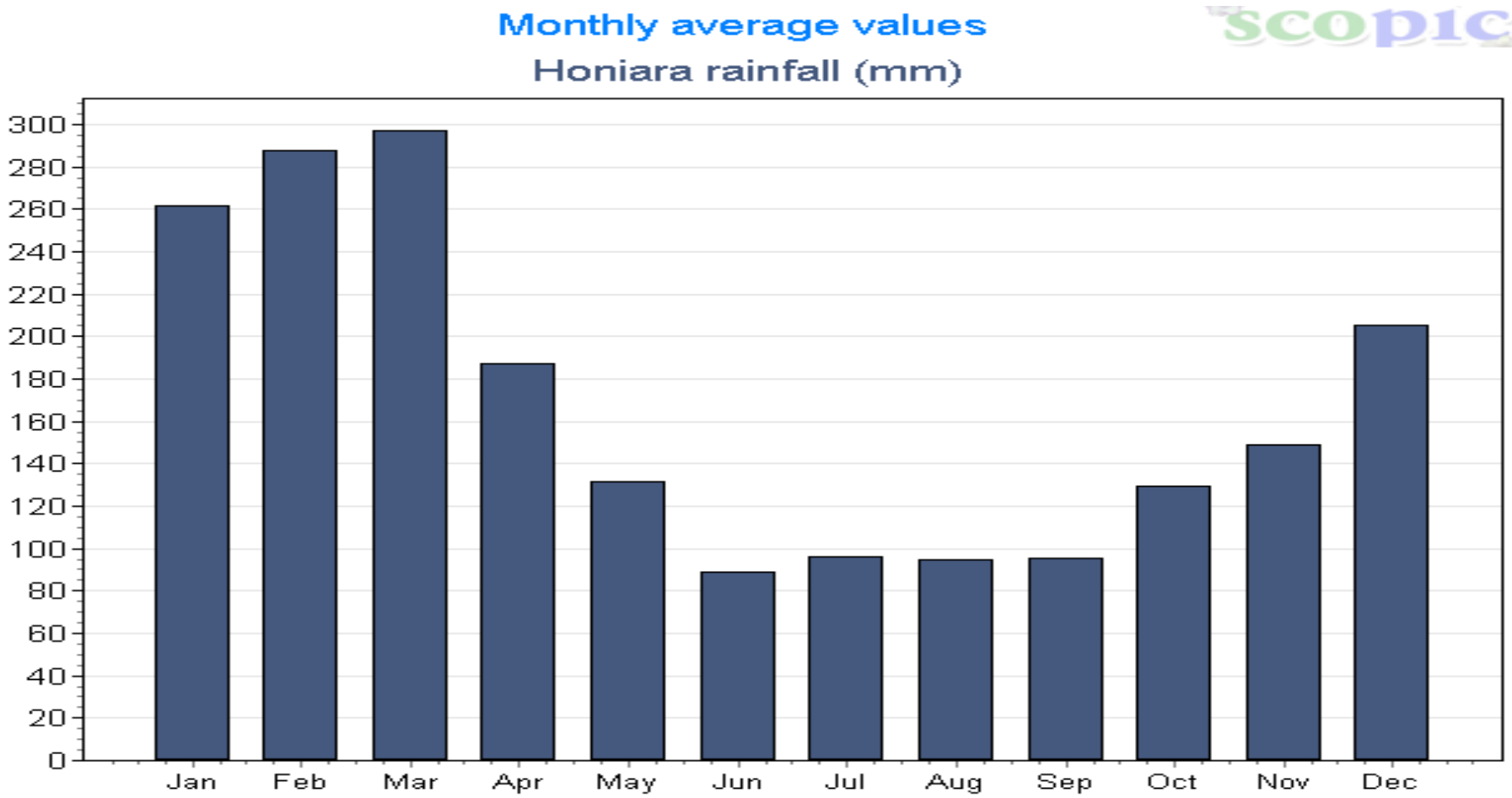
Prediction of Vector-born diseases (Malaria)



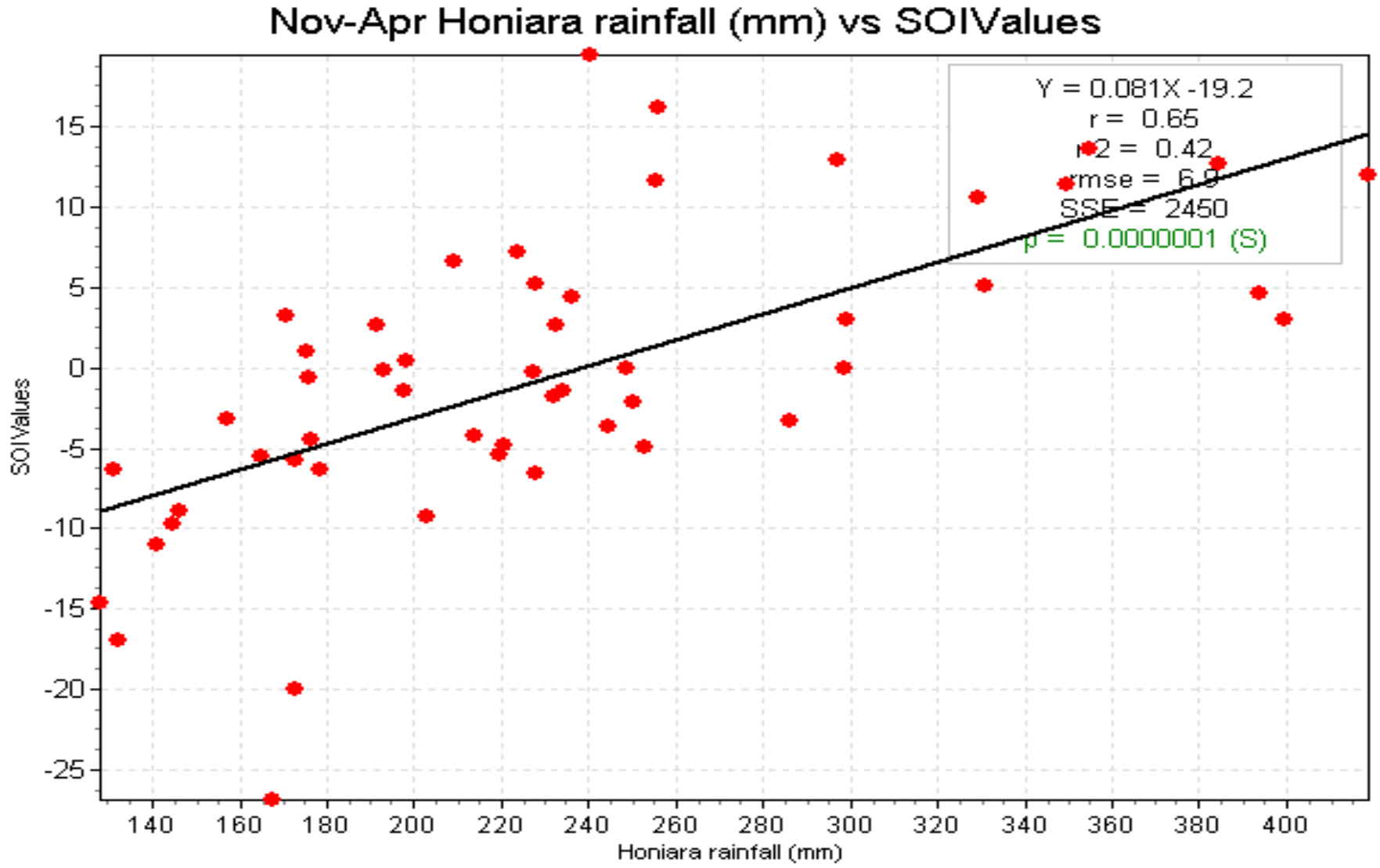
Aims

- **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.**

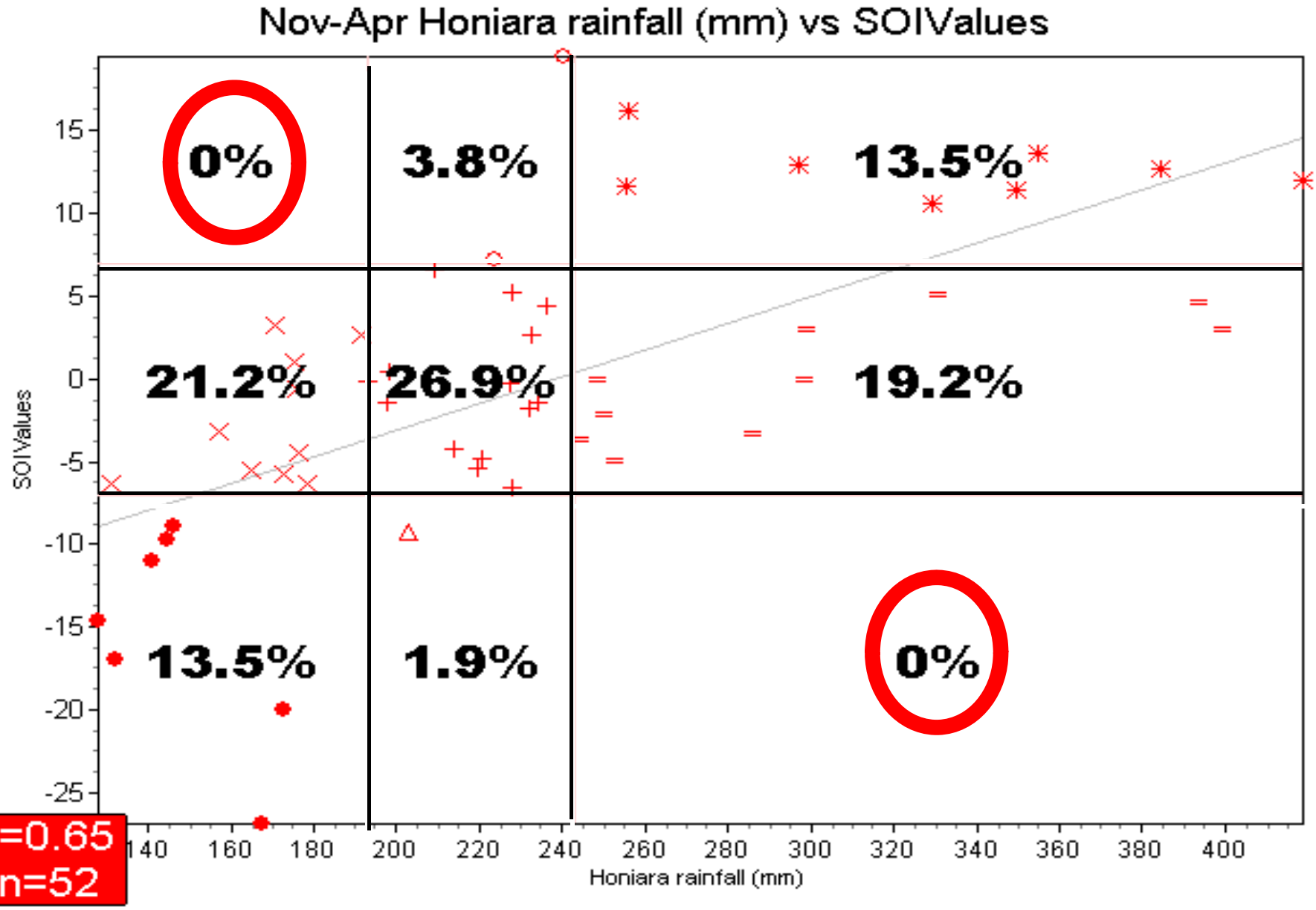
Climate of Solomon Islands



Concurrent relationship between SOI and Rainfall



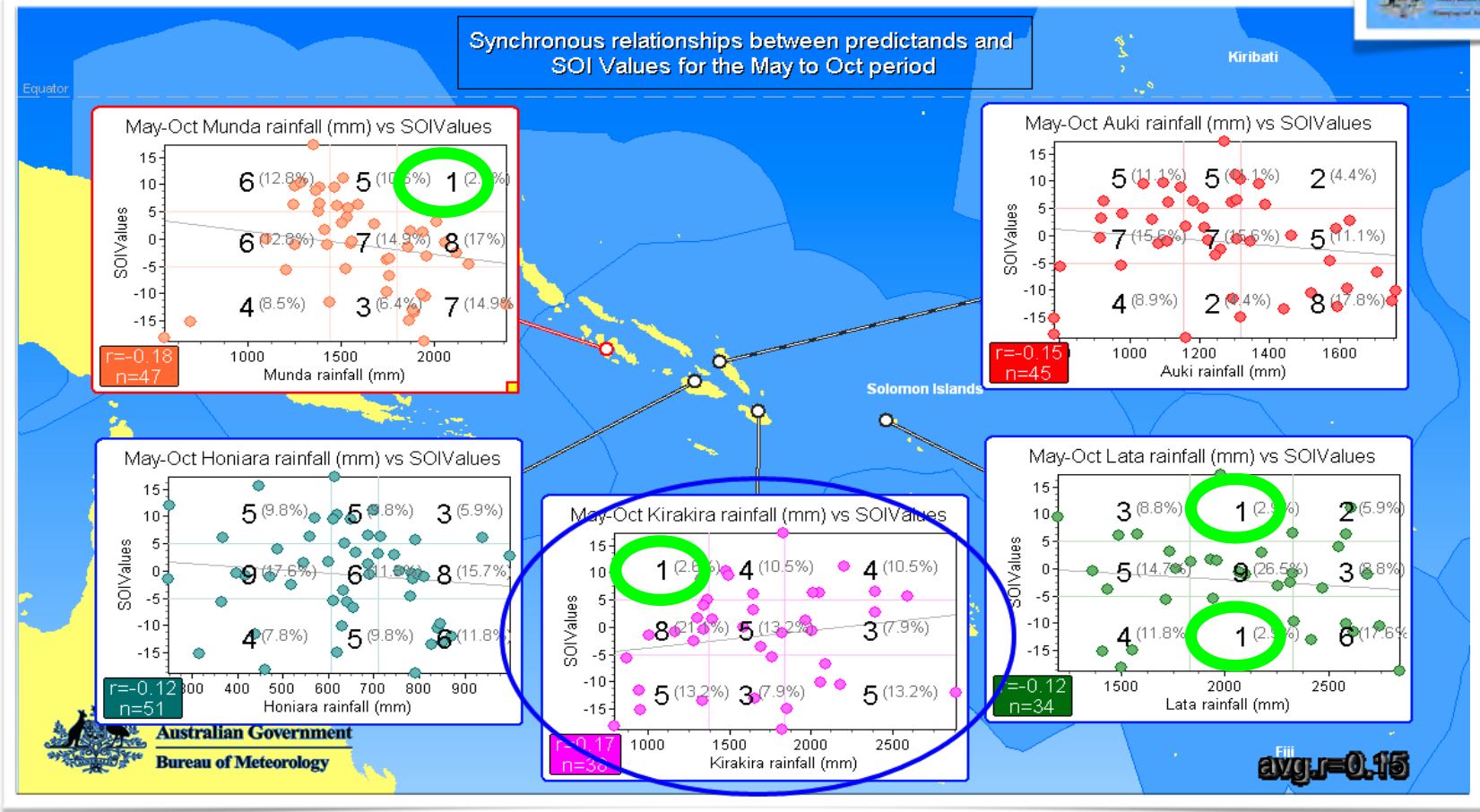
ıpling regression analysis for Nov 2009-Apr 2010 Predictands (6mth Averag
using 6mth avg SOI Values (Nov-Apr) (-6mths lead)



Solomon Islands

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

Concurrent relationship between rainfall and SOI (May – October)



Ratings

May-Oct

Nov-Apr

Solomon Islands

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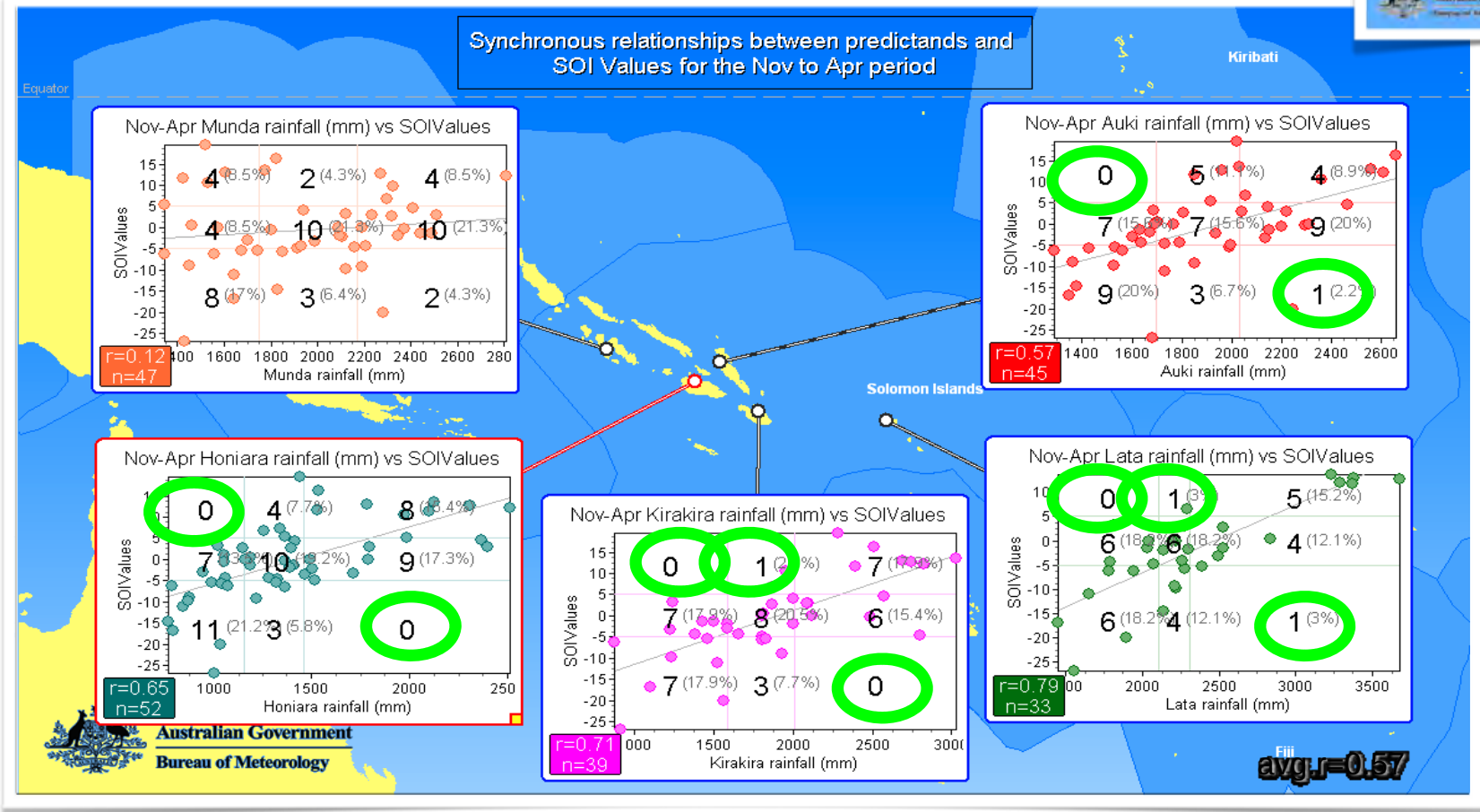
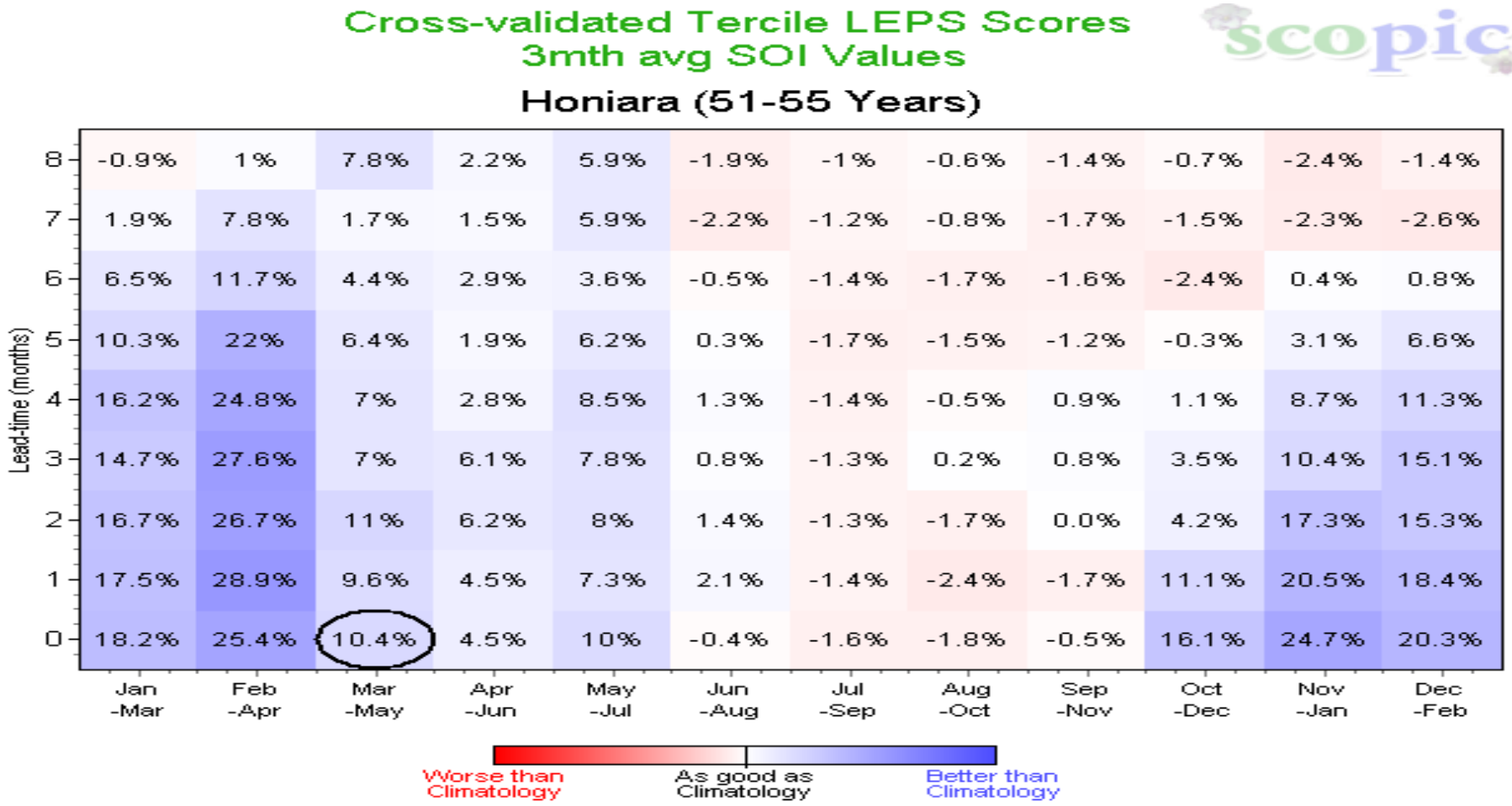


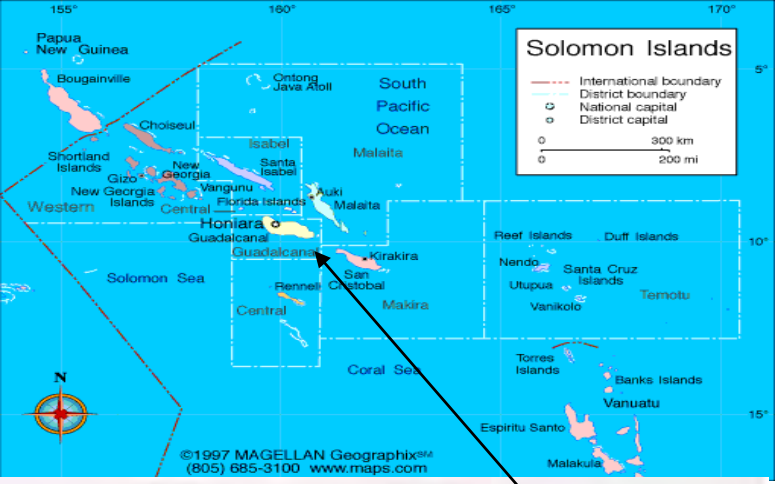
Ratings

May-Oct

Nov-Apr

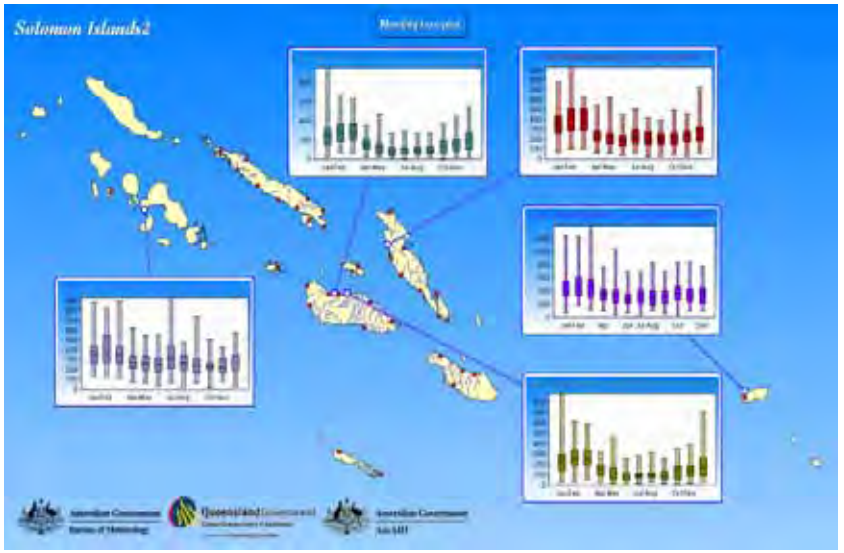
Rainfall Prediction Skill



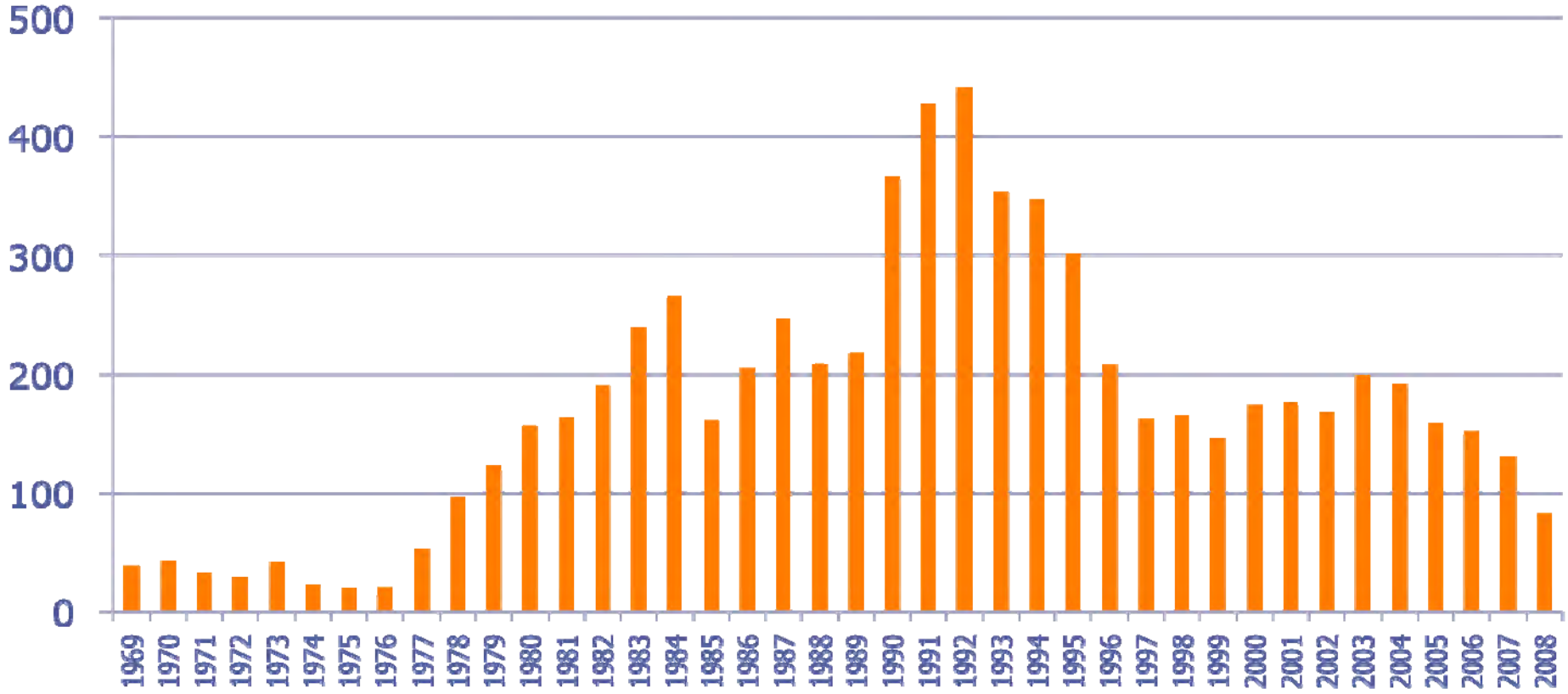


Malaria Snapshot

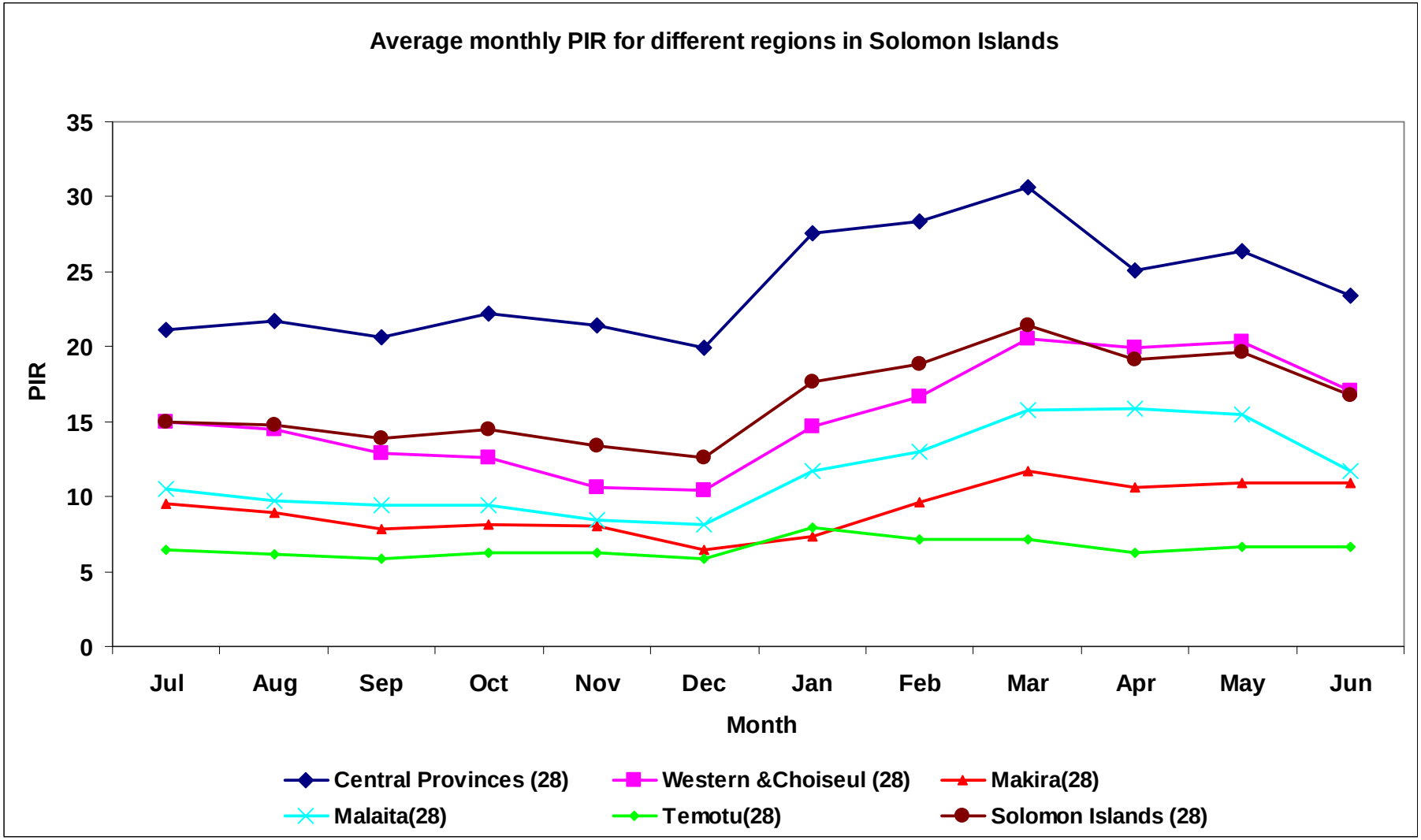
- 100 countries, 40% of world population live in areas where malaria transmission occurs
- 300 – 500 million cases each year world wide
- 750,000 – 2 million deaths each year
- Plasmodium *falciparum* accounts for 60-70% of all cases in SI. Transmitted by Anopheles Mosquitoes
- Ideal breeding condition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



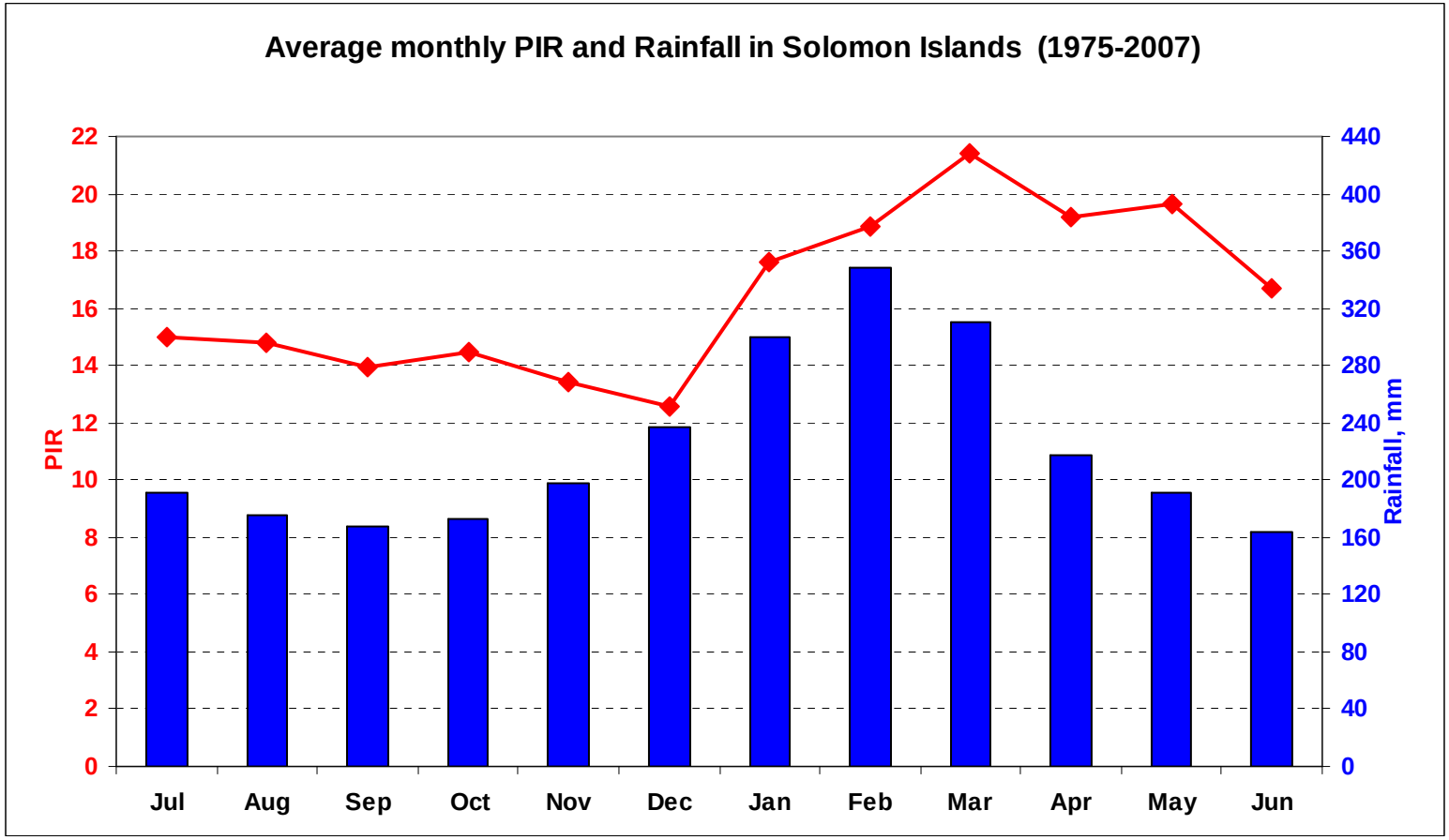
Annual incidence of slide confirmed malaria since 1969 in Solomon Islands



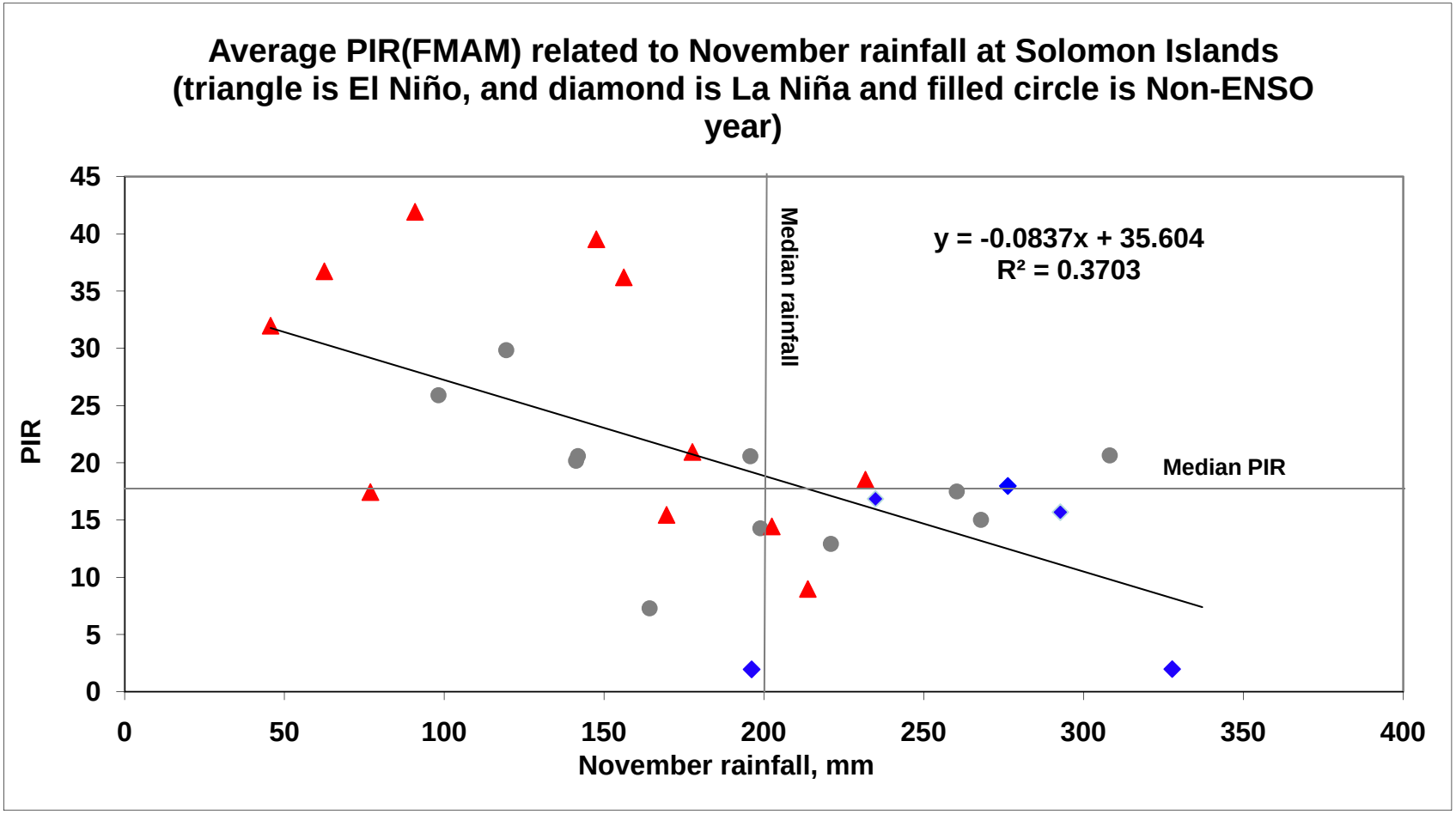
Average monthly malaria PIR distributions for different regions in Solomon Islands

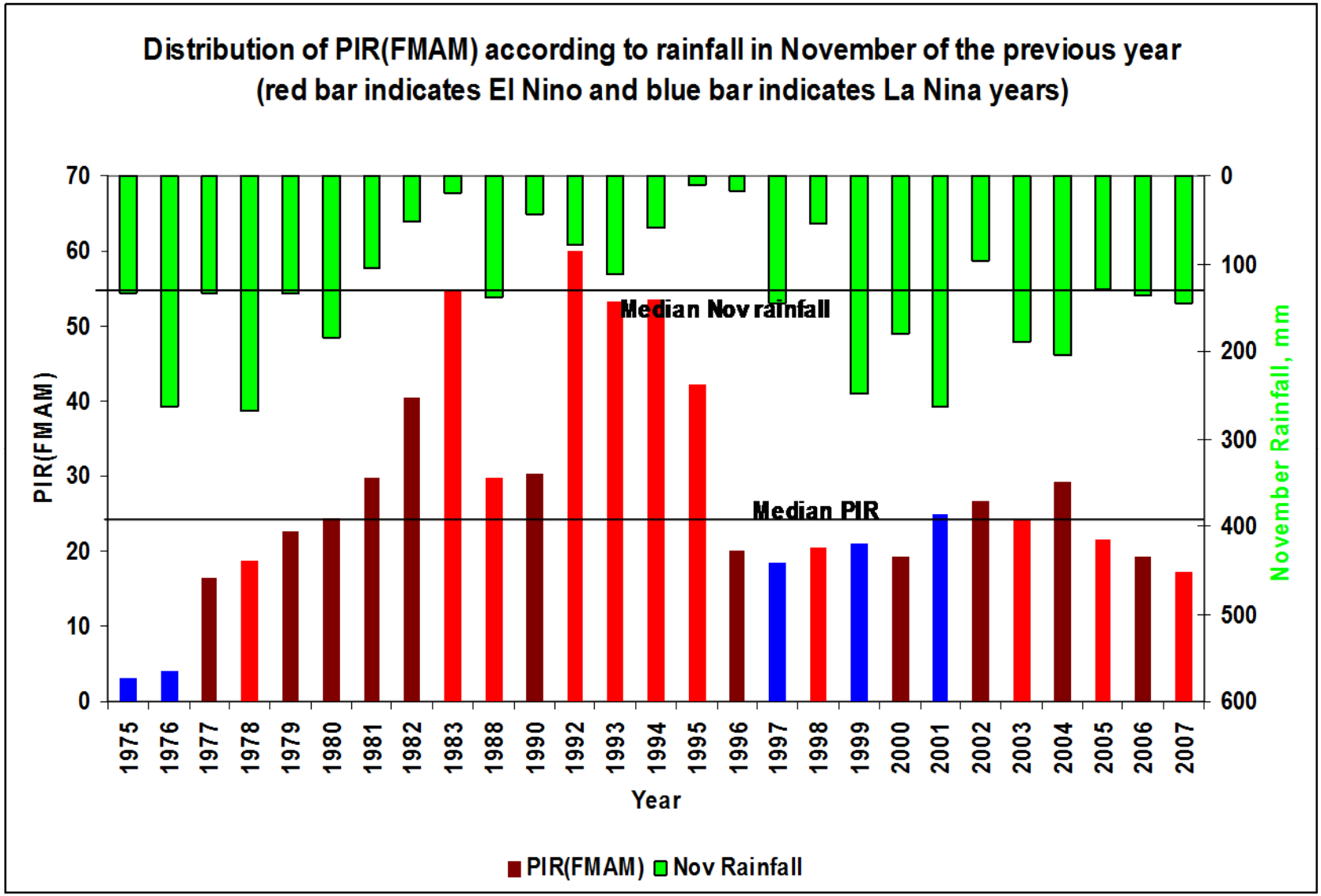


Positive Incidence Ratio (PIR) per 1000 population

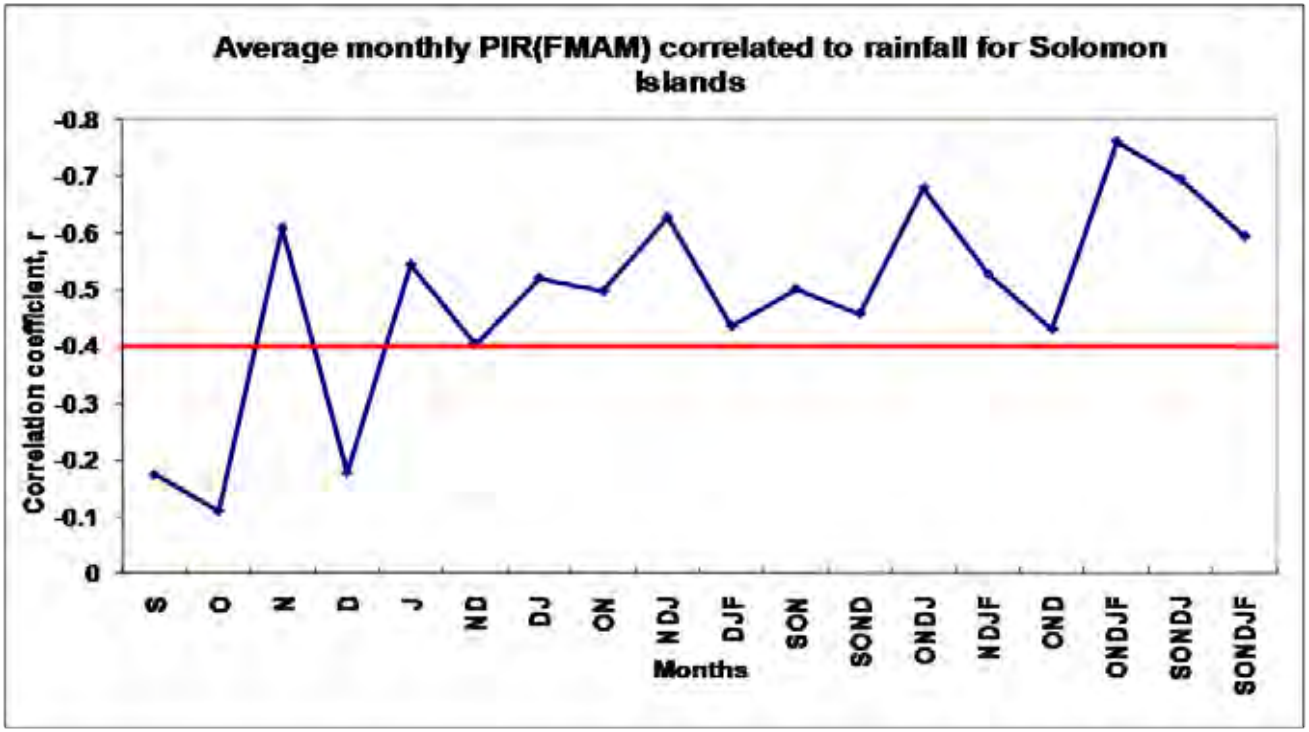


Average PIR (FMAM) vs November rainfall

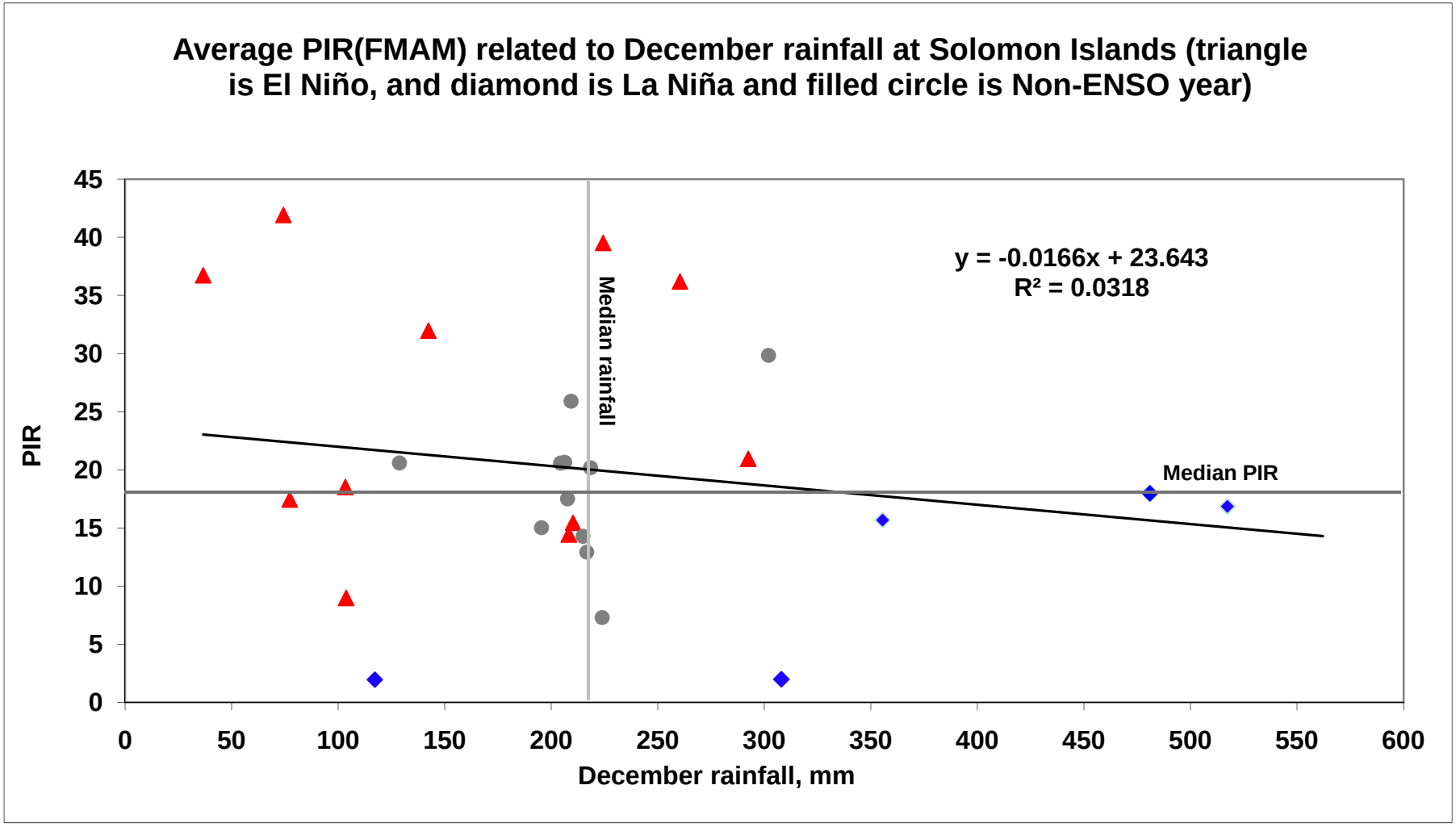



Distribution of PIR(FMAM) according to rainfall in November of the previous year
(red bar indicates El Nino and blue bar indicates La Nina years)
PIR(FMAM)
November Rainfall, mm
Median Nov rainfall
Median PIR
Year
1975
1976
1977
1978
1979
1980
1981
1982
1983
1988
1990
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
PIR(FMAM)
Nov Rainfall

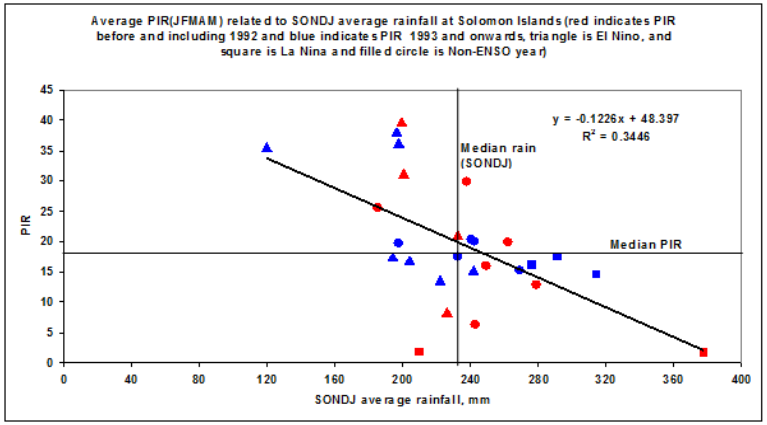
Average monthly PIR (FMAM) related to average monthly rainfall from September through to February



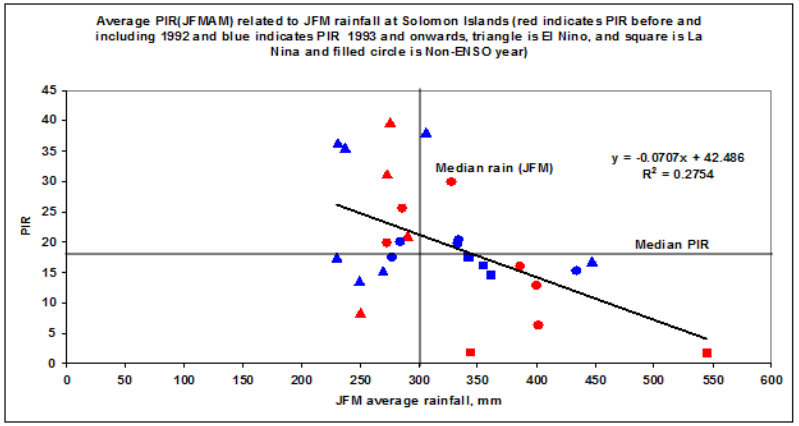
Average PIR (FMAM) vs December rainfall



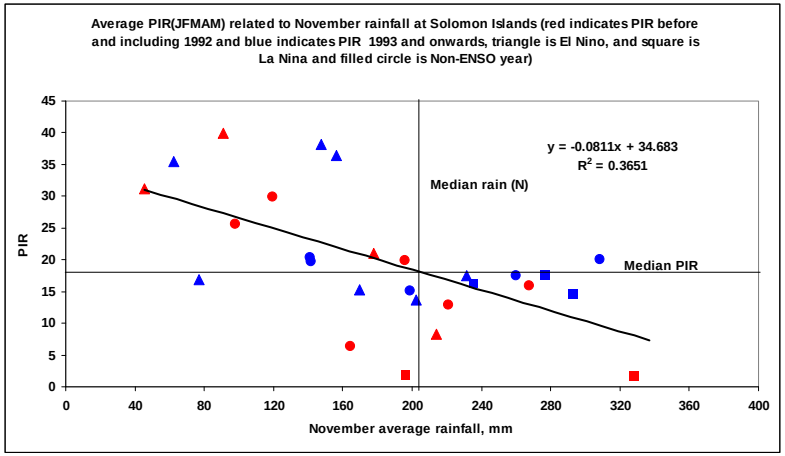
Average PIR(JFMAM) vs rainfall in SONDJ



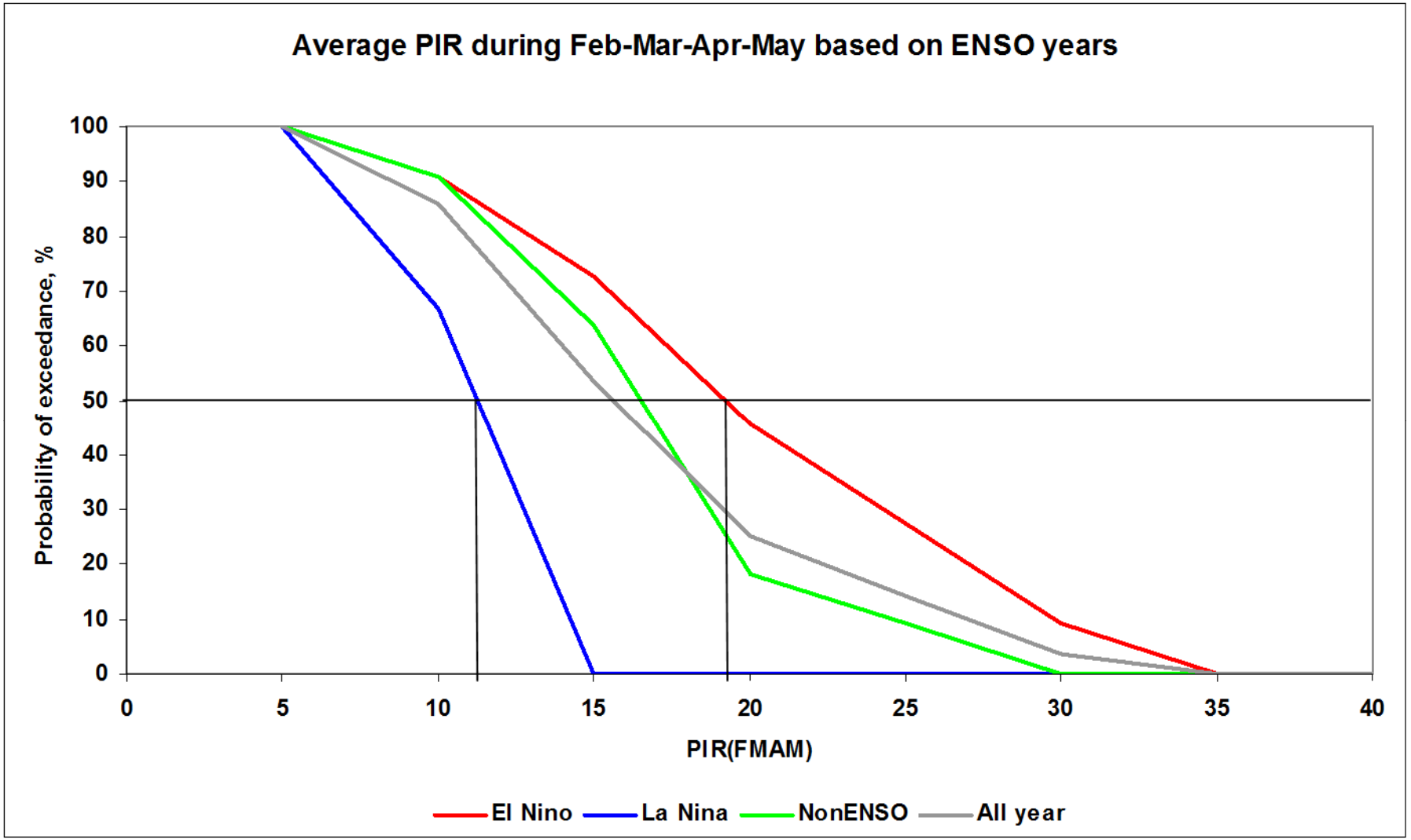
Average PIR(JFMAM) vs rainfall in JFM



Average PIR(JFMAM) vs rainfall in September



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	

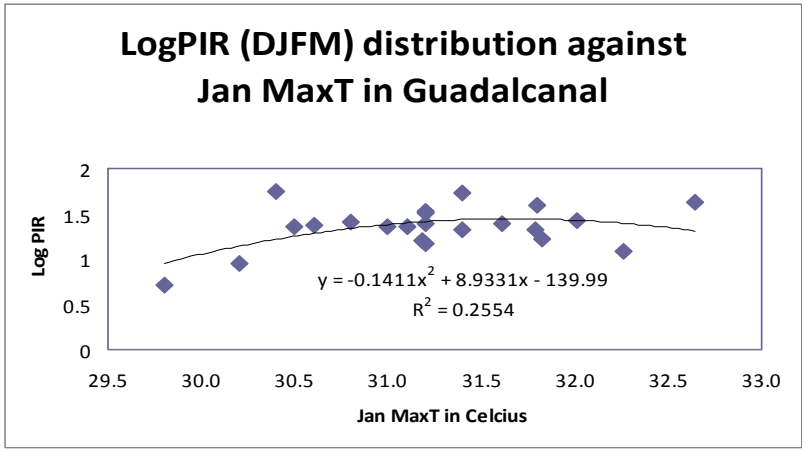
Rueda LM, Patel KJ, Axtell RC, Stinner RE: **Temperature-dependent development and survival rates of Culex quinquefasciatus and Aedes aegypti (Diptera: Culicidae).** *J Med Entomol* 1990, **27**:892-898.

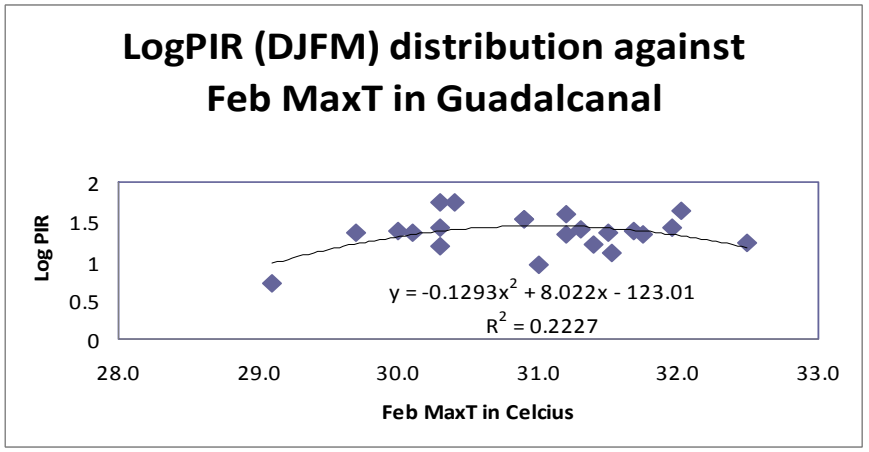
MacDonald G: **The epidemiology and control of malaria.** London: Oxford University Press; 1957.

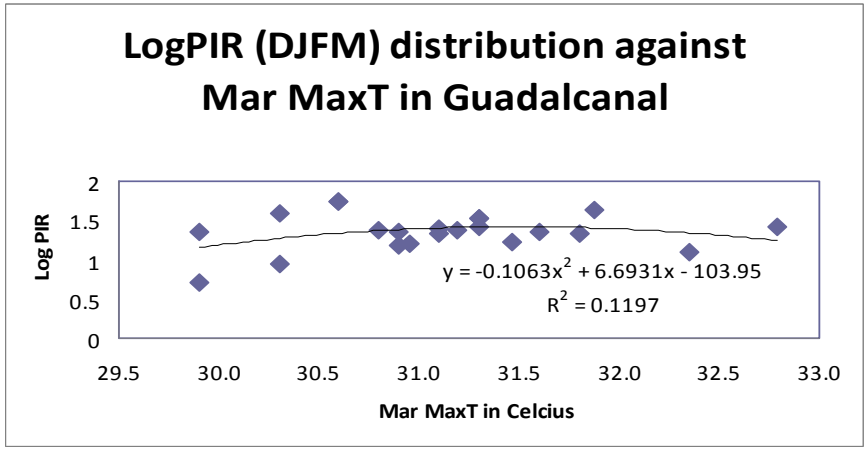
le Sueur D BLS: **Temperature dependent variation in Anopheles Merus larval head capsule width and adult wing length: implications for anopheline taxonomy.** *Med Vet Entomol* 1991:55-62.

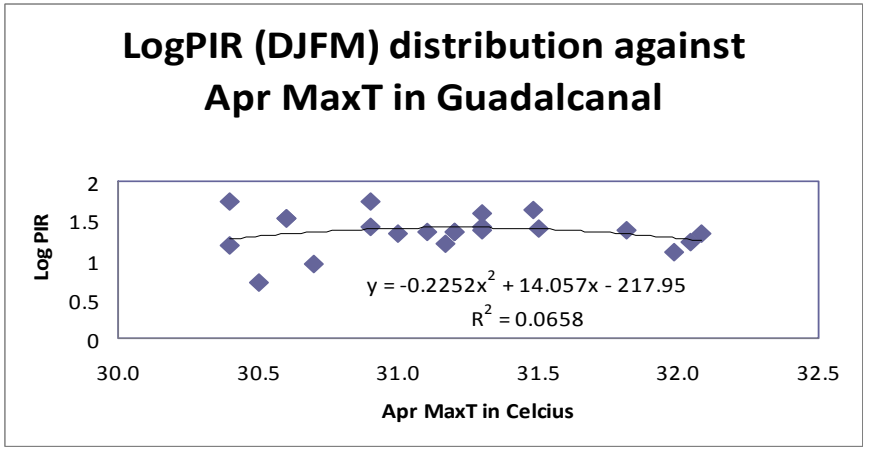
Detinova TS: **Age-grouping methods in Diptera of medical importance, with special reference to some vectors of malaria.** *Monogr Ser World Health Organ* 1962, **47**:13-191.

PIR and Maximum Temperature

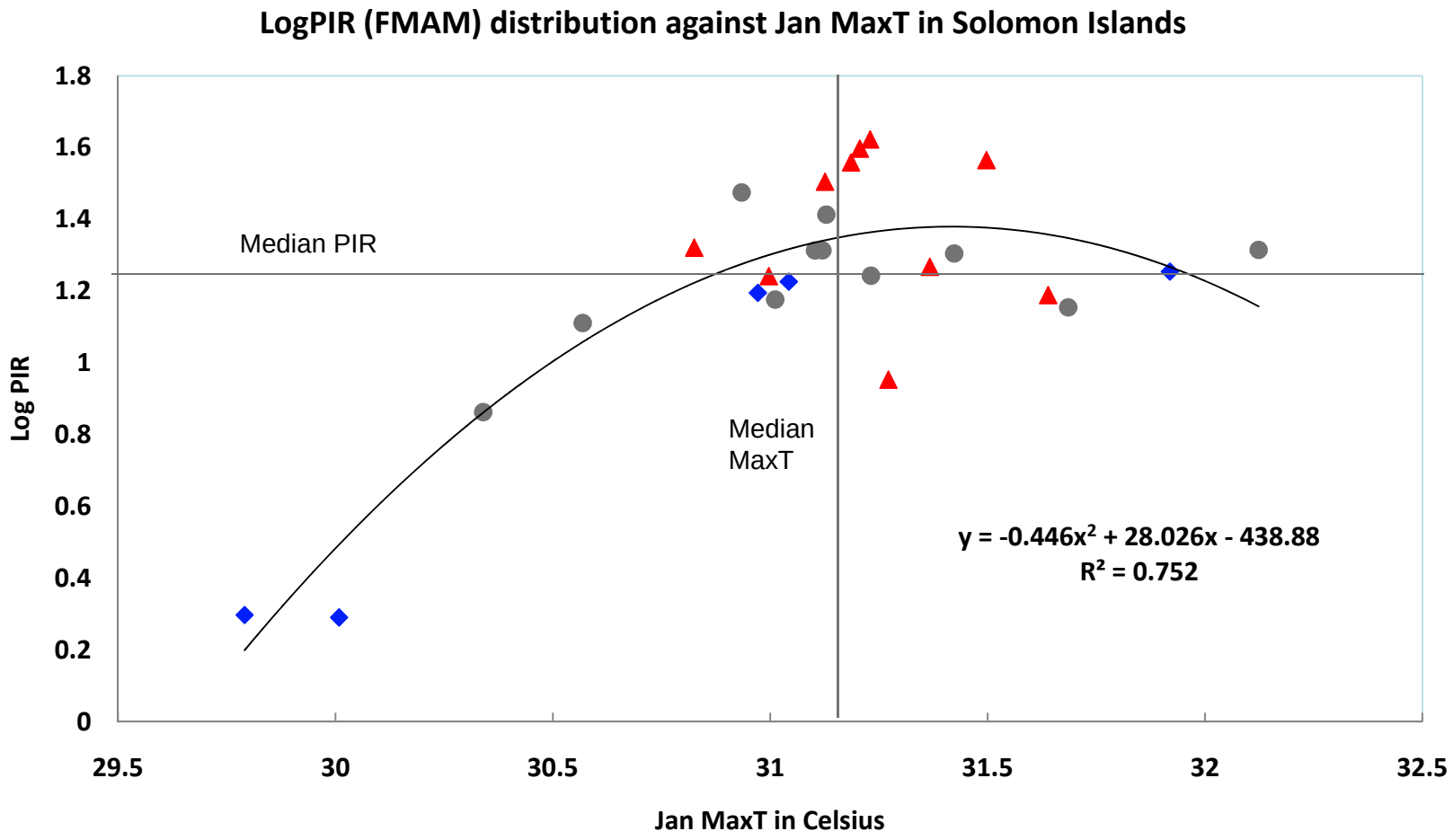




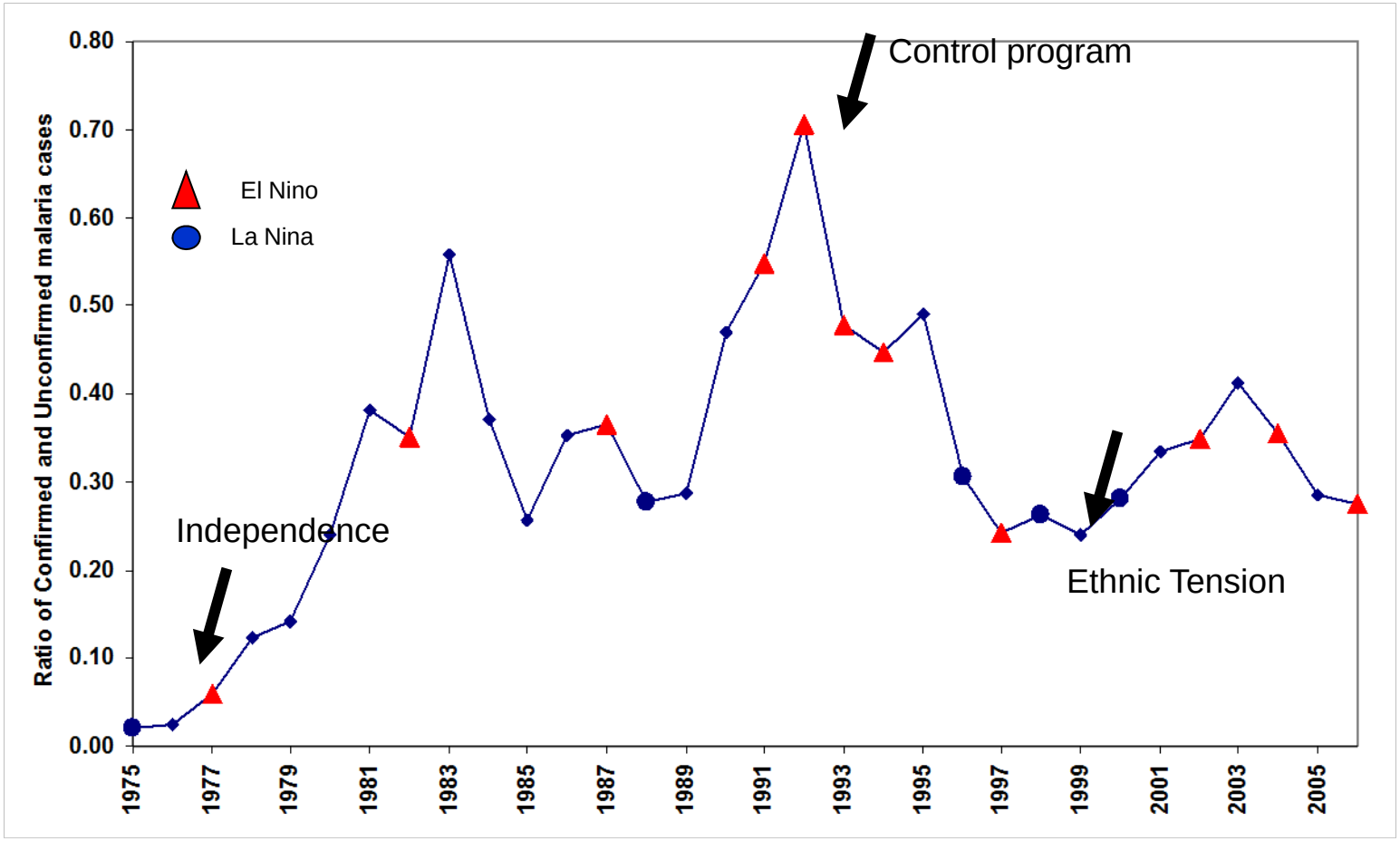




PIR (FMAM) distribution of malaria as a function of maximum temperature in January in Solomon Islands (Triangle indicates El Niño, Diamond is La Niña and the rest are Non-ENSO years)



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

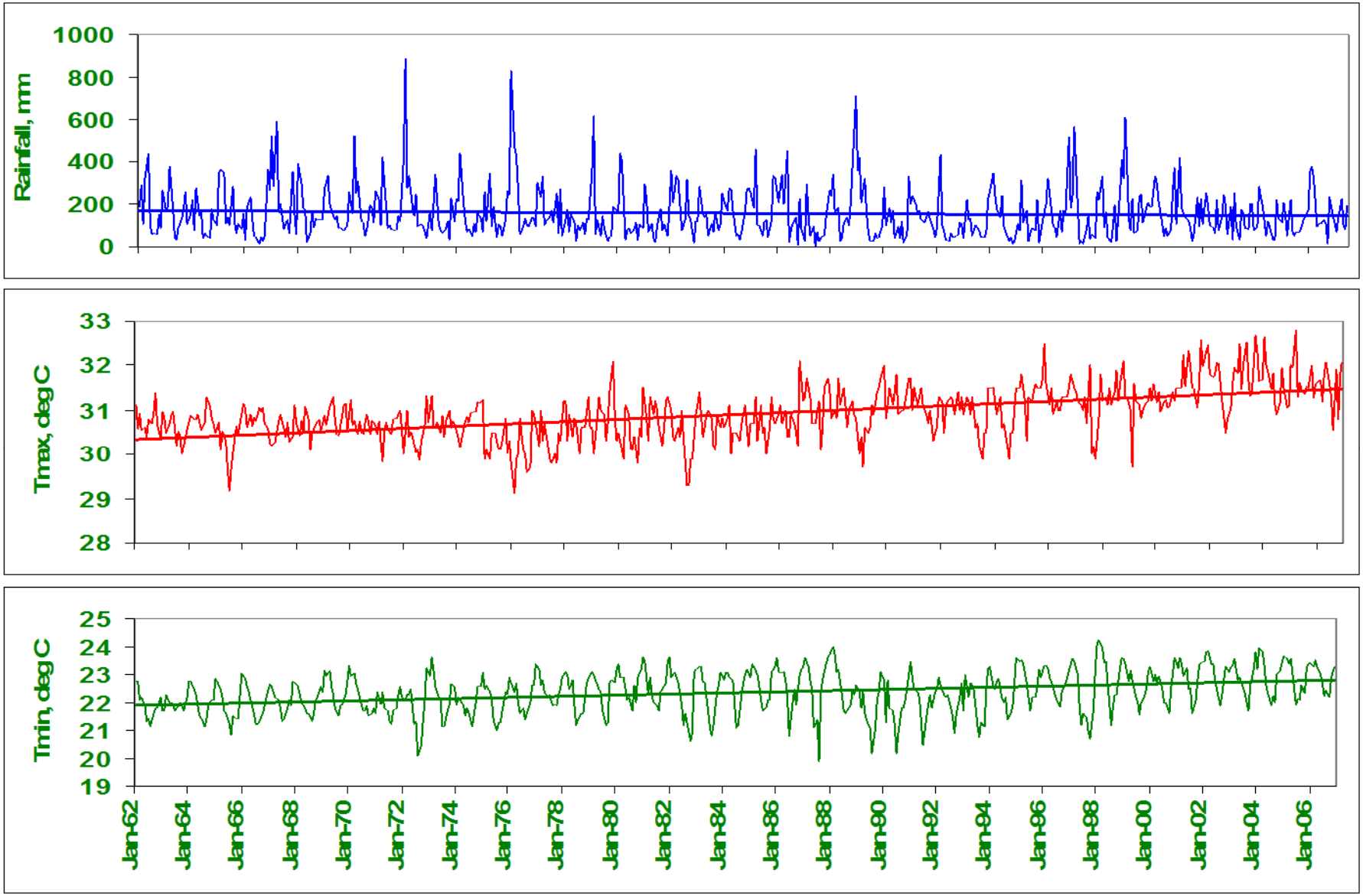


Non-climatic and climate related inter-annual variability in annual confirmed malarial incidence for Solomon Islands for 1975-2006

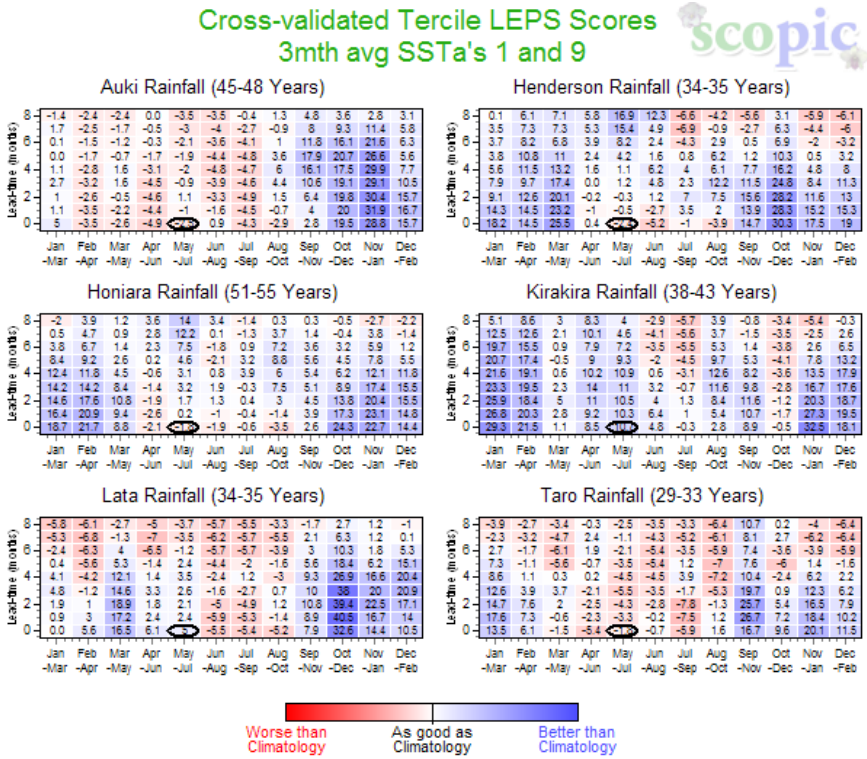
Model	Multiple r	r^2	Adjusted r^2	Standard Error
1	0.61	0.37	0.35	0.26
2	0.66	0.44	0.40	0.24
3	0.88	0.78	0.74	0.16

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)



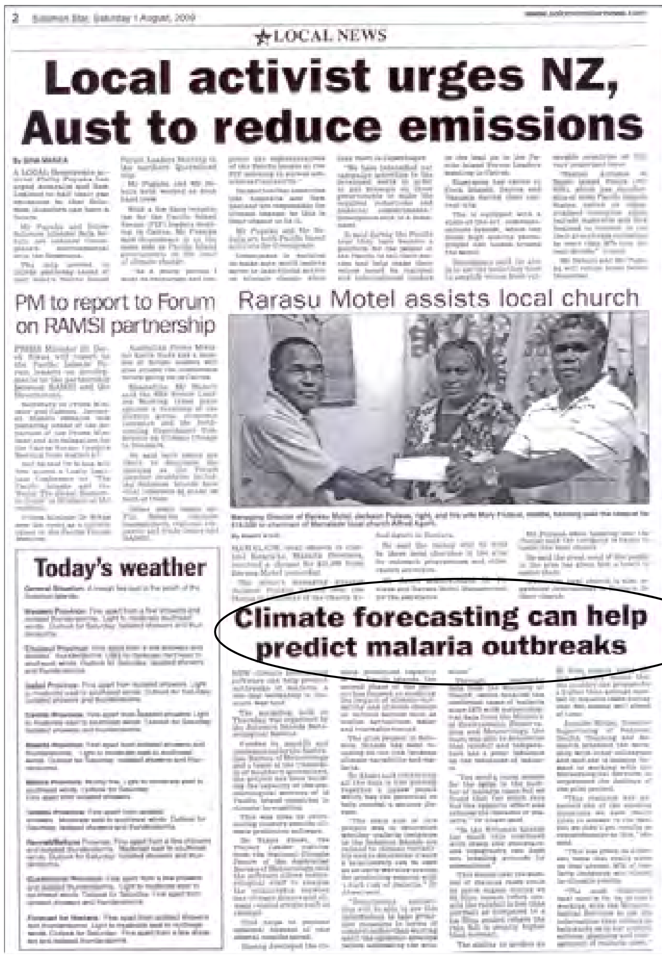
Predictability of rainfall in Solomon



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



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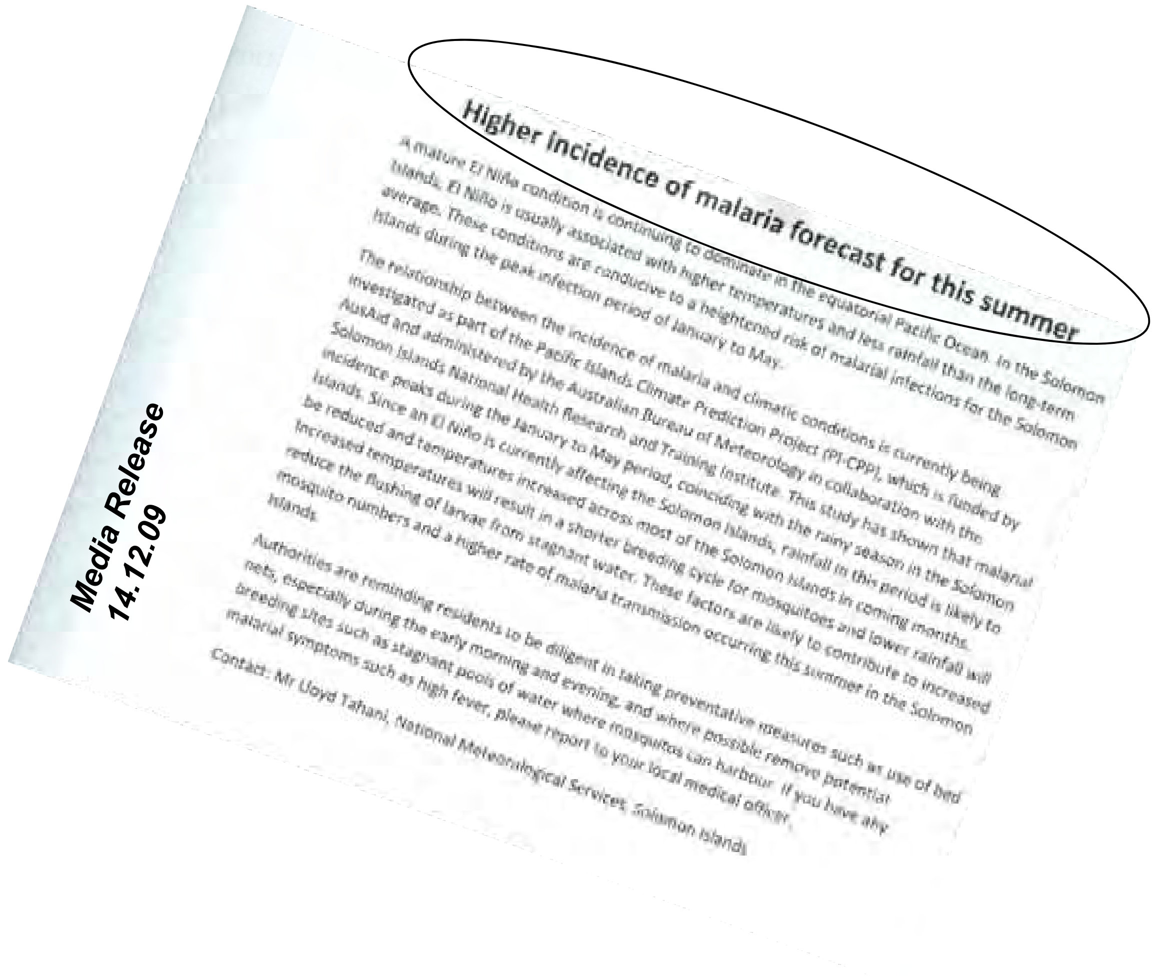
Local activist urges NZ, Aust to reduce emissions

PM to report to Forum on RAMSI partnership

Rarasu Motel assists local church

Today's weather

Climate forecasting can help predict malaria outbreaks



Media Release
14.12.09

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.

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 mosquitos 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