International Climate Change Adaptation Initiative

Seasonal Forecasting of Climate Extremes: Droughts and Floods

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Outline

- Introduction - ICCAI
- Rainfall variability in the Western Pacific
- The 2012 Fiji floods
- The 2011 Tuvalu drought
- Seasonal climate prediction - effective way to adapt to climate variability and change

International Climate Change Adaptation Initiative (ICCAI)

- Australia supports high priority climate change adaptation needs in vulnerable countries in our region.
- The primary geographic emphasis of the AusAID–DCCEE jointly–managed International Climate Change Adaptation Initiative (ICCAI, $350 M , 2008-2013) is on Australia's neighbouring island countries.
- The Pacific Climate Change Science Program (PCCSP) and the Pacific Adaptation Strategy Assistance Program (PASAP), 2009–2011, helped Pacific island countries and East Timor better understand how climate change will impact on them.
- The Pacific Australia Climate Change Science and Adaptation Planning (PACCSAP) Program, 2012-2013, was a continuation of the PASAP and PCCSP, with a focus on climate extremes.

Pacific Adaptation Strategy Assistance Program; Pacific Climate Change Science Program; Pacific Australia Climate Change Science & Adaptation Planning Program

PACCSAP Partner countries

Cook Islands

East Timor

Federated States of Micronesia

Fiji

Kiribati

Niue

Palau

Papua New Guinea

Republic of Marshall Islands

Republic of Nauru

Samoa

Solomon Islands

Tonga

Tuvalu

Vanuatu

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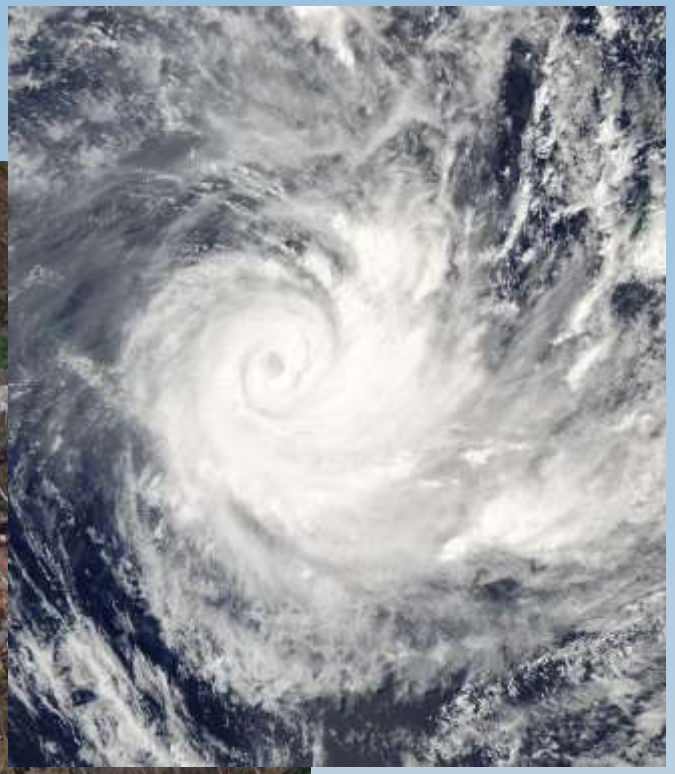
Climate extremes in the Western Pacific

- Little knowledge about current climate of the Pacific Island Countries and climate projections prior to PCCSP research.
- Climate extremes have a major impact on Pacific Island countries, and their changes over the coming decades are expected to drive many of the most significant effects of climate change.
- Of particular concern are tropical cyclones, hydrological extremes (droughts and floods), sea level extremes and unusually warm ocean temperatures, and their impacts through severe weather, coastal inundation and coral bleaching.

Floods in the Pacific



Severe flash flooding associated with TC Evan in Samoa in Dec 2012.

- Severe floods frequently affect major infrastructure, transportation, business and property in Pacific Island Countries.
- Often significant flooding is attributed to a tropical cyclone or a tropical depression.

The 2012 Fiji Floods

- In January 2012, a tropical disturbance was stationary over few days and caused heavy rainfall which resulted in widespread flooding and landslides.
- Eight people died in the floods and thousands of people were displaced.
- Estimated losses due to the January 2012 flood were about FJ$ 40 million.
- The March 2012 flood was the worst flood to affect Fiji in recent times in terms of both the magnitude and the damage to properties.
- Torrential rain and subsequent flooding resulted in landslides and destruction of major roads and bridges.
- The maximum flood water level recorded by Nadi River gauge before it malfunctioned was 7.6m.
- Damage caused by the March 2012 flood was estimated at around FJ$70 million.

Droughts in the Pacific

- On the other side of hydrological extremes are droughts which also frequently affect islands of the Pacific impacting on the countries to a various degrees of severity depending on the drought's length.
- In extreme cases, droughts affect countries to such an extent that they cause devastating water crisis (e.g. the 2011 drought in Tuvalu).
- This prolonged drought episode was related to a strong La Niña event which affected the region in 2010-11.

Meteorological drought affected Fiji in 2010

800 hectares of forests were destroyed by fire in Samoa in 2011

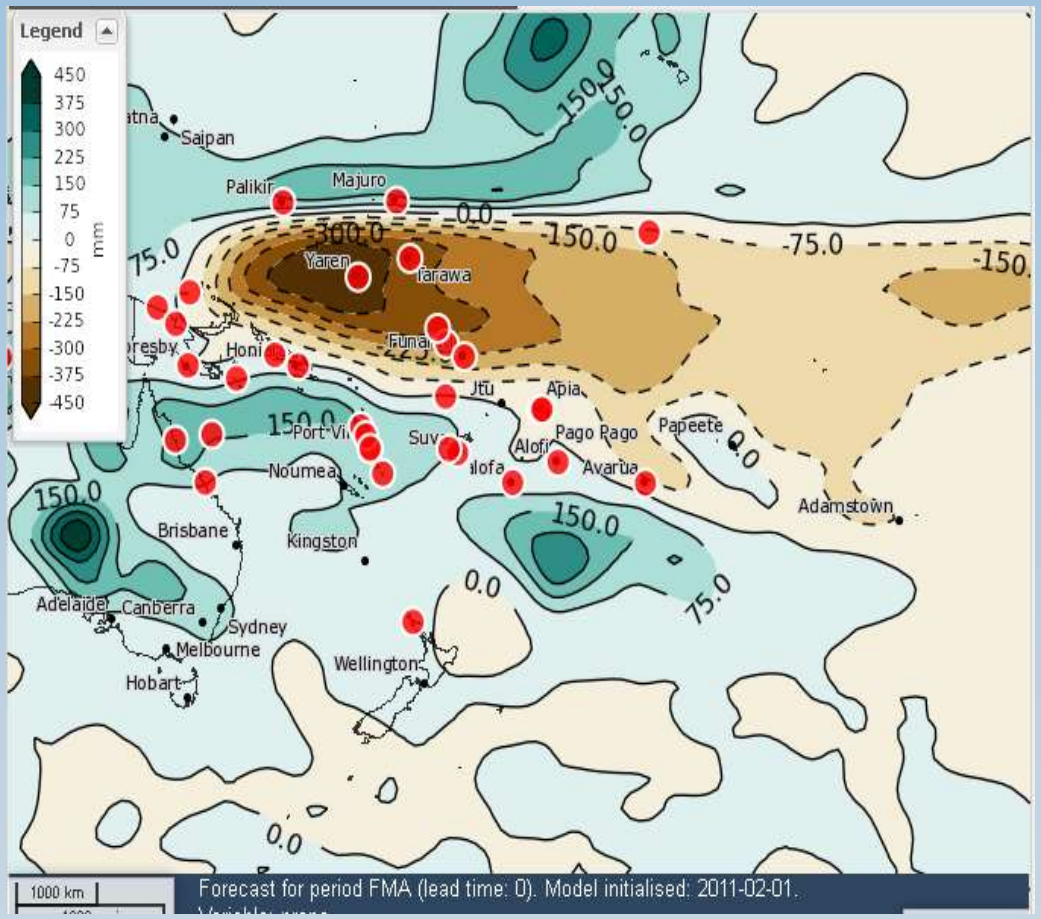
Droughts in the Pacific

- In 2011, a number of countries and territories in the region, including Samoa, Tokelau and Tonga were affected by La Niña-induced rainfall deficit; however, Tuvalu was particularly seriously impacted.
- On the 28 September 2011, the government of Tuvalu declared a state of emergency due to critically low water supplies.
- Households were rationed to about 40 litres of fresh-water a day as some parts of Tuvalu had just a two day supply of water left.
- The situation was critical and the governments of Australia, Japan, New Zealand and South Korea immediately began delivering fresh water supplies and portable desalination plants.

Seasonal Climate Prediction

- Modern science of seasonal climate prediction is well developed, with current dynamical climate models being able to provide skilful predictions of regional rainfall two-three months in advance.
- Under the PASAP and the PACCSAP programs research has been conducted to evaluate the skill of the dynamical climate model POAMA (Predictive Ocean Atmosphere Model for Australia) for predicting seasonal rainfall.
- The probability of accumulated rainfall falling in the lower climatological tercile (i.e. an elevated risk of below average rainfall) for the Western Central Pacific in 2011 was predicted by POAMA.

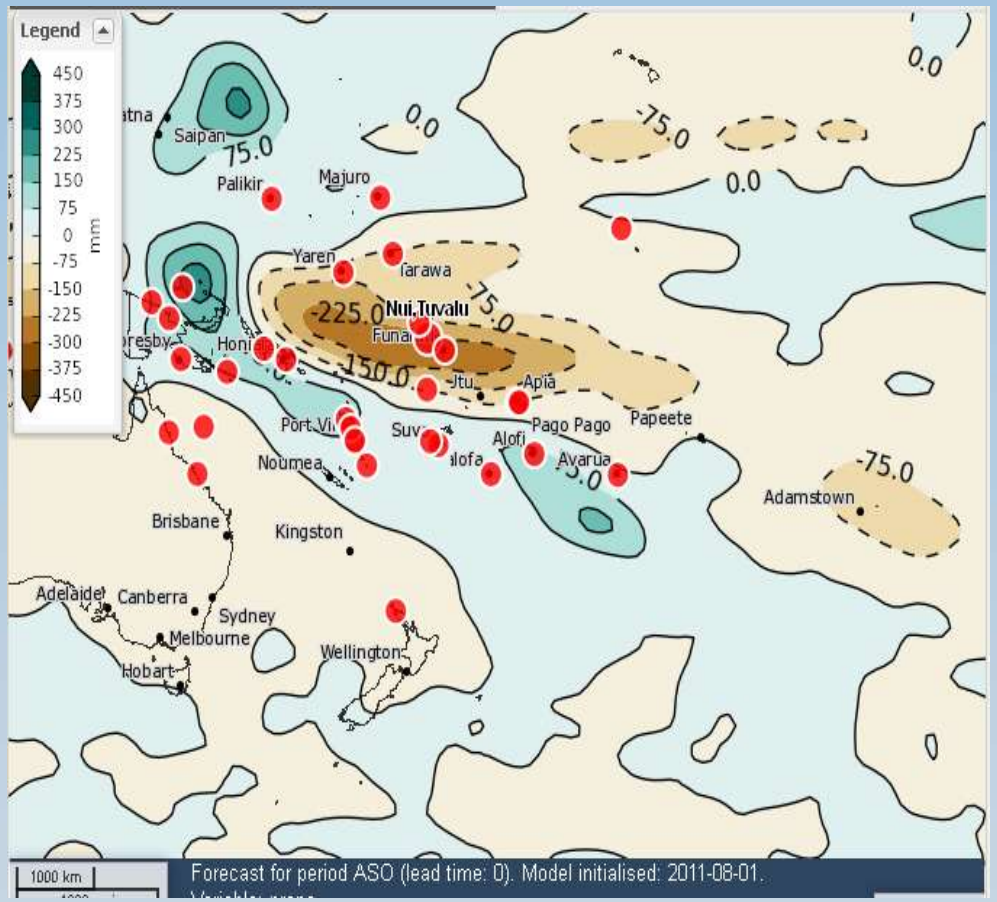
The Pacific Seasonal Climate Prediction Portal



The POAMA-based seasonal forecast issued in February 2011 for the three-month period February-March-April (FMA) predicted that the rainfall deficit in the area of Tuvalu would continue, with the ensemble mean forecast quantity of seasonal rainfall about 225 mm below average.

POAMA-based prediction of seasonal rainfall anomalies in the South Pacific region. The seasonal forecasts issued in February 2011 for three-month period FMA.

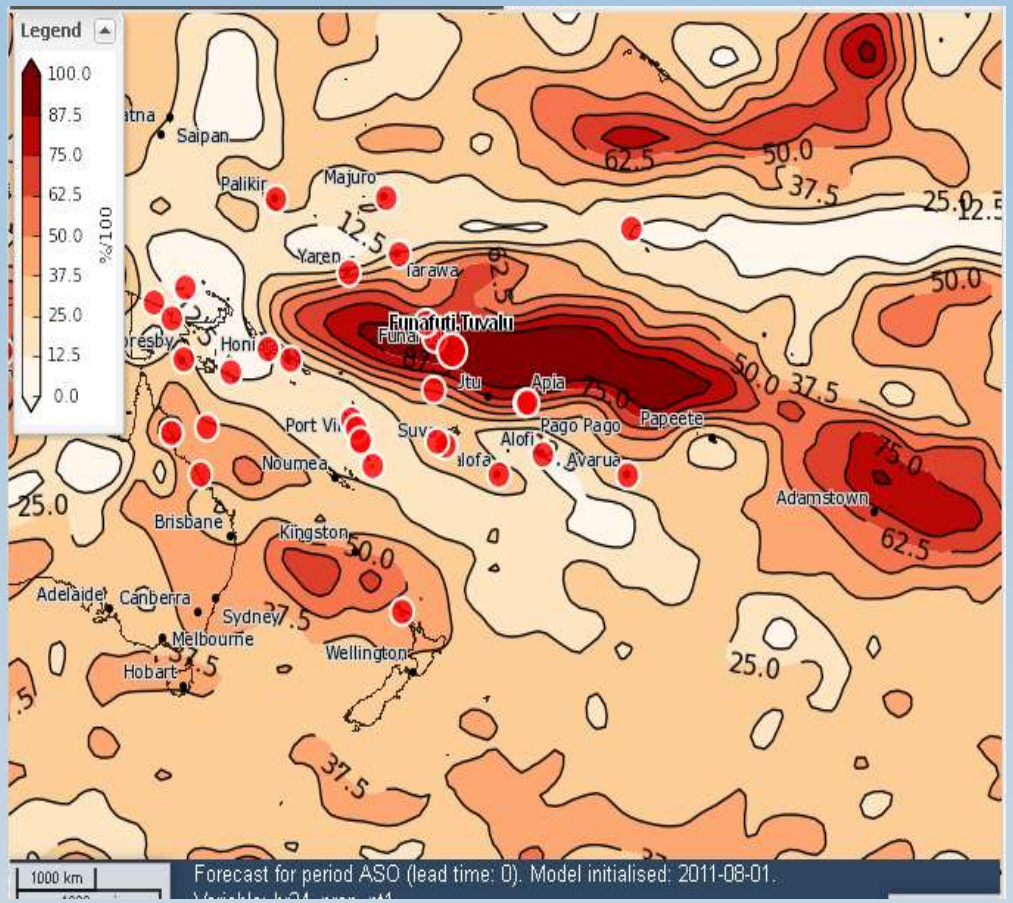
The Pacific Seasonal Climate Prediction Portal



POAMA-based prediction of seasonal rainfall anomalies in the South Pacific region. The seasonal forecasts issued in February 2011 for three-month period ASO.

Subsequent forecasts from POAMA, produced monthly, consistently indicated that rainfall deficits would further continue, e.g. the forecast for August-September-October (ASO), issued in August 2011, predicted a rainfall deficit greater than 225 mm.

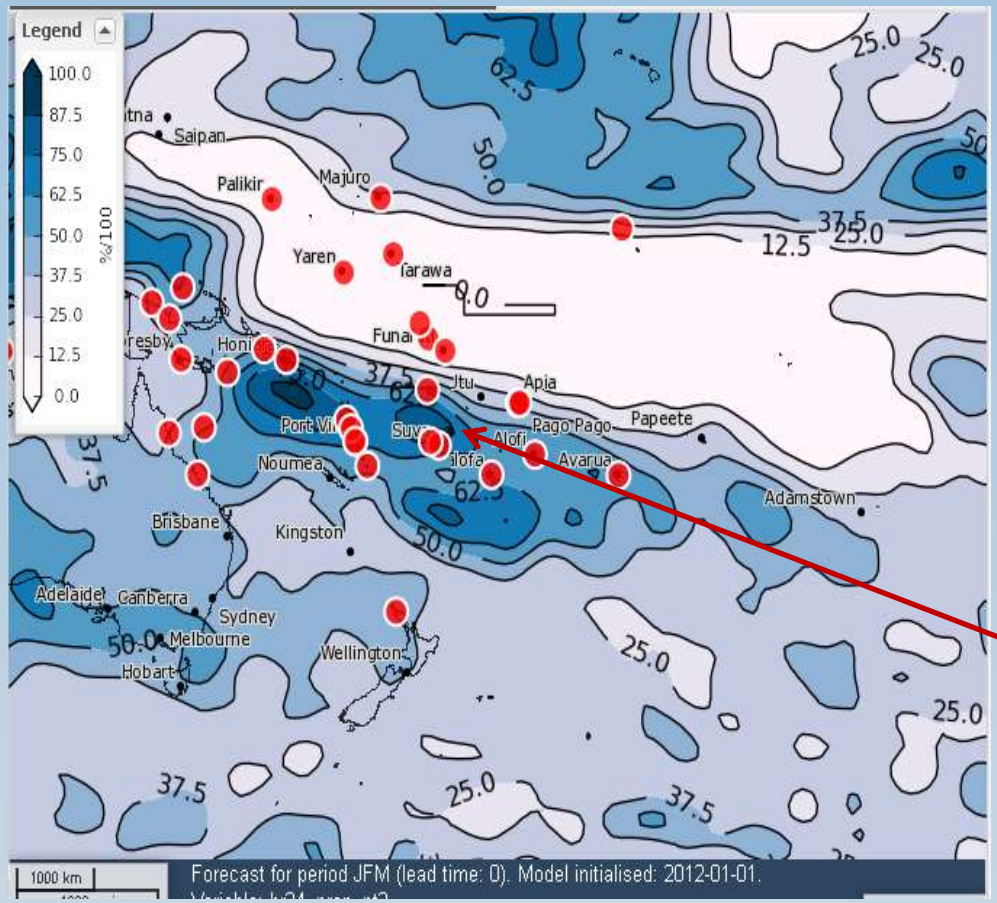
The Pacific Seasonal Climate Prediction Portal



- Information available from POAMA from the beginning of 2011 consistently indicated high probability of continuous drought in the region.
- If used in a timely manner, such information could be used as a trigger for early preventive actions to reduce the impact of water shortages on the local population.

Probability of accumulated rainfall in the lower climatological tercile (more than 87.5% in the region containing Tuvalu) predicted by POAMA for ASO 2011.

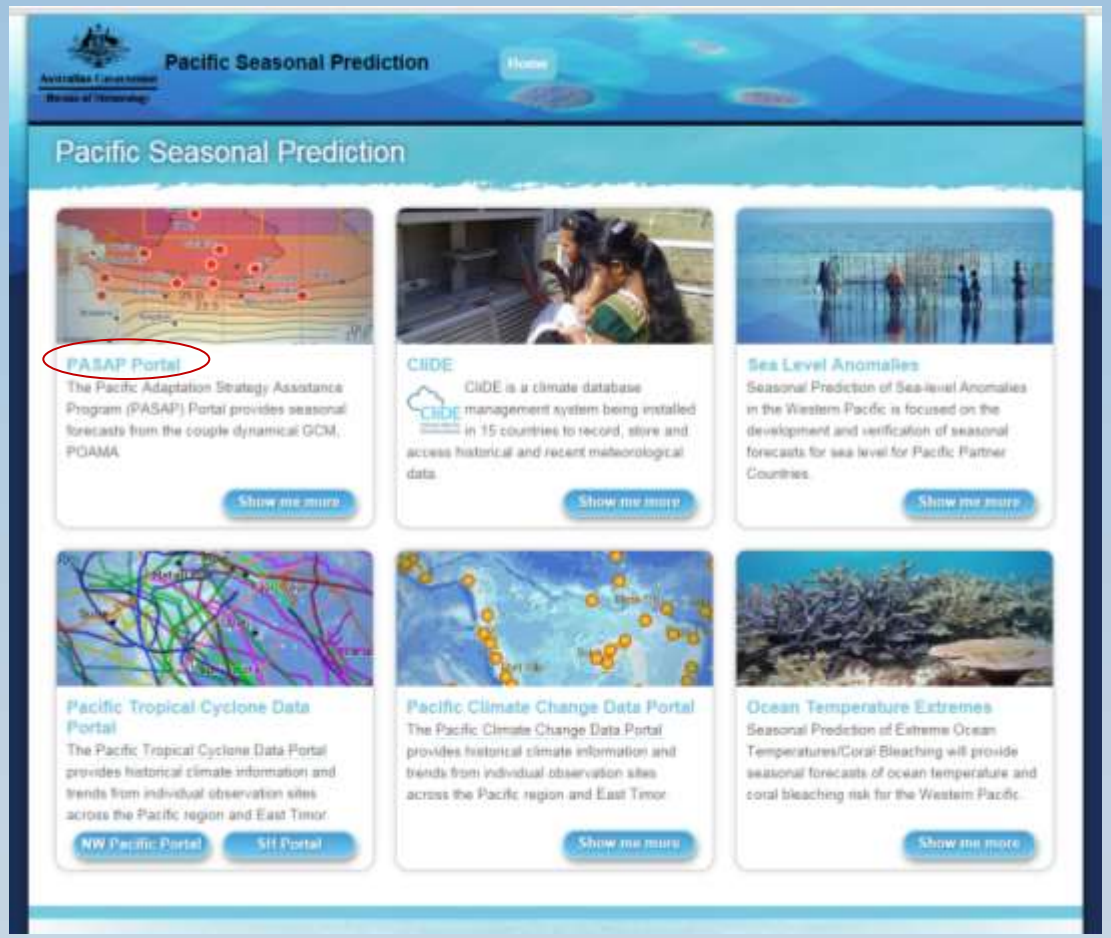
The Pacific Seasonal Climate Prediction Portal



Probability of accumulated rainfall in the higher climatological tercile (more than 75%) predicted by POAMA for JFM 2012.

- POAMA's outputs could be used with confidence for forecasting both rainfall deficit leading to droughts and excessive rainfall potentially leading to floods.
- High probability (above 75%) of wetter than normal seasonal conditions is predicted by POAMA in the area of Fiji for January-February-March (JFM) 2012.

The Pacific Seasonal Climate Prediction Portal



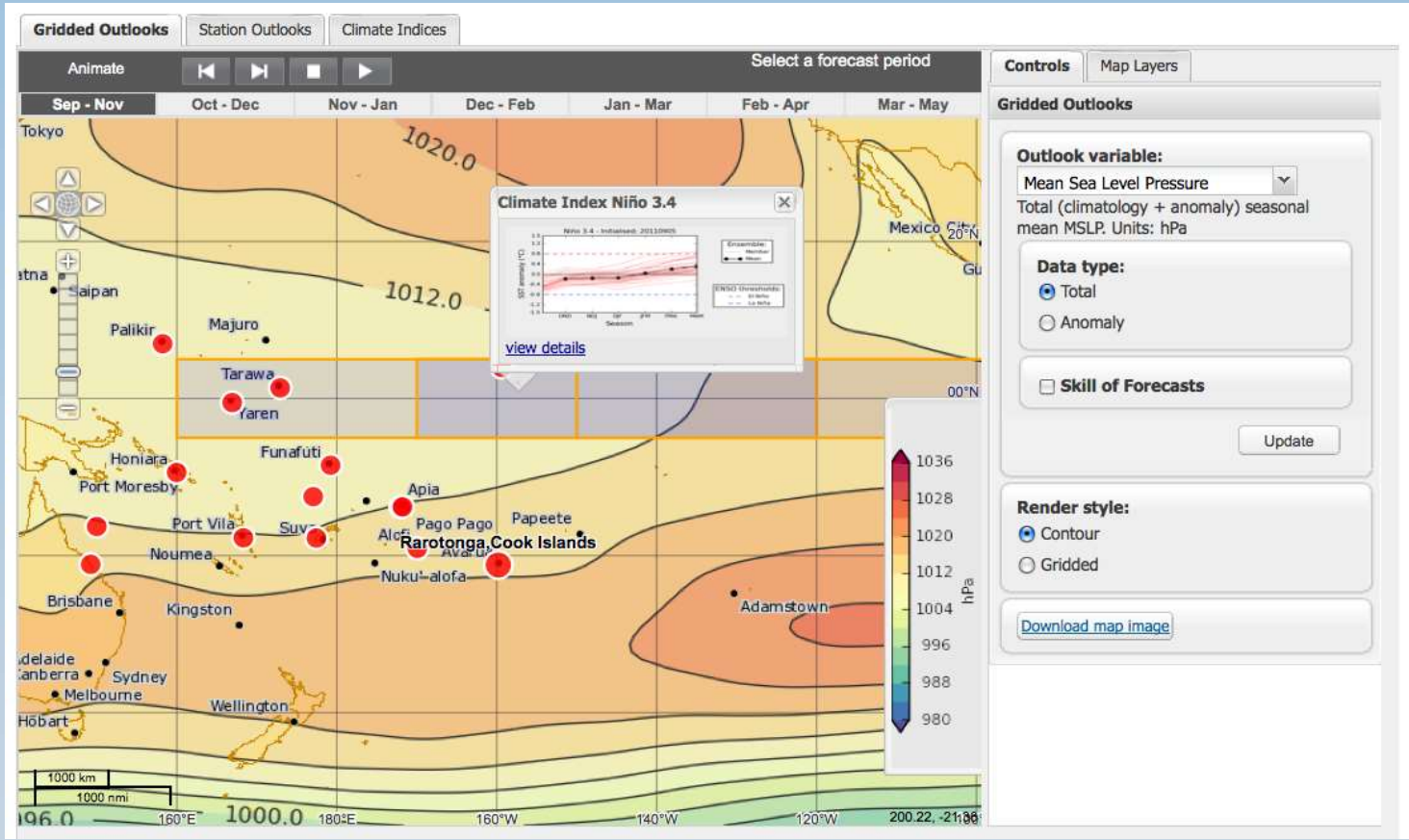
http://www.bom.gov.au/climate/pacific/projects.shtml

A range of web-based information tools have been developed to assist National Meteorological and Hydrological Services of 15 island countries in the Western Pacific with climate change adaptation:

- Climate Data for the Environment (CliDE)
- Pacific climate change data portal
- Seasonal climate prediction portal
- Pacific tropical cyclone data portal
- Sea level anomalies
- Ocean temperature extremes

Pacific Adaptation Strategy Assistance Program; Pacific Climate Change Science Program; Pacific Australia Climate Change Science & Adaptation Planning Program

The Pacific Seasonal Climate Prediction Portal



The dynamic climate model-based forecast products are now disseminated to the National Meteorological and Hydrological Services of 15 island countries in the Western Pacific through the PASAP Seasonal Prediction Portal.

Pacific Adaptation Strategy Assistance Program; Pacific Climate Change Science Program; Pacific Australia Climate Change Science & Adaptation Planning Program

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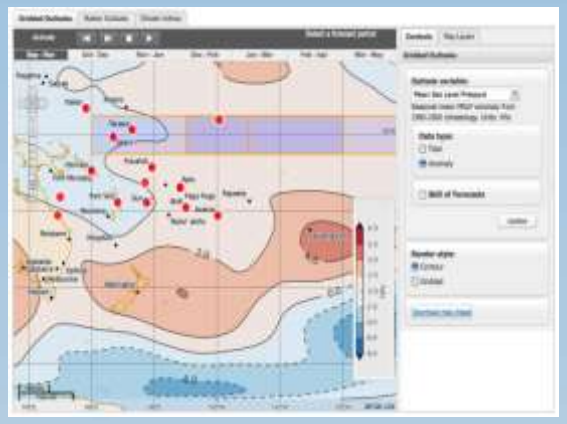
The Pacific Seasonal Climate Prediction Portal

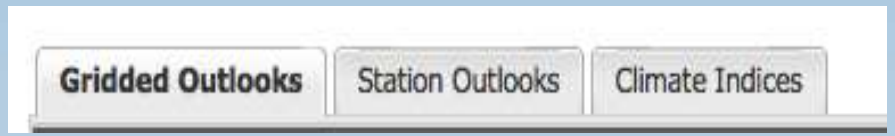


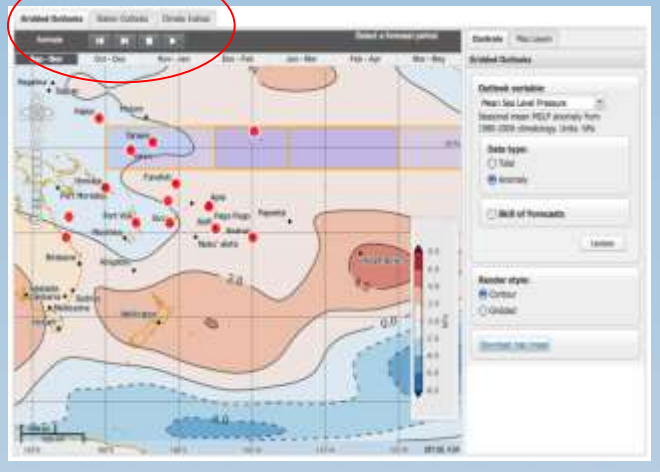
The Pacific Seasonal Climate Prediction Portal provides access to outlooks for

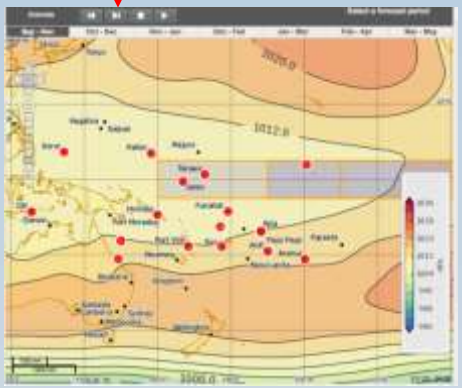
- Broad scale fields
- Climate drivers (ENSO)
- Rainfall and temperature tercile probabilities for selected sites
- Hindcast skill scores for all outlooks

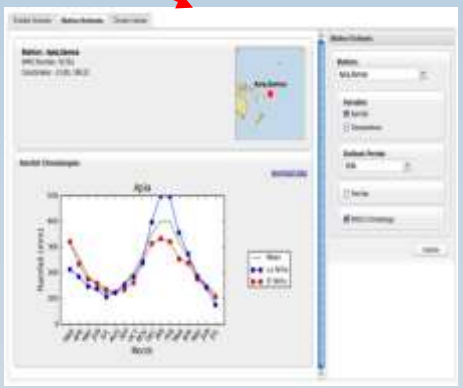
Outlooks are based on the Bureau of Meteorology's POAMA seasonal forecasting system.

Selecting an Outlook Type



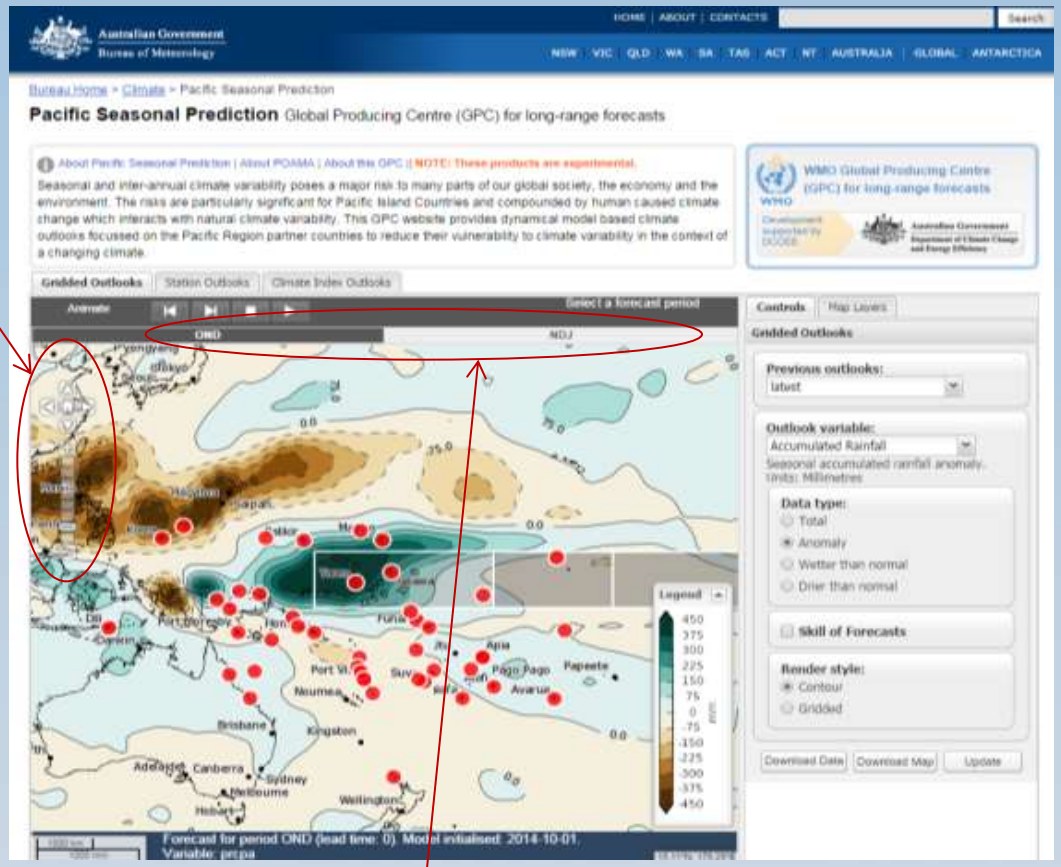






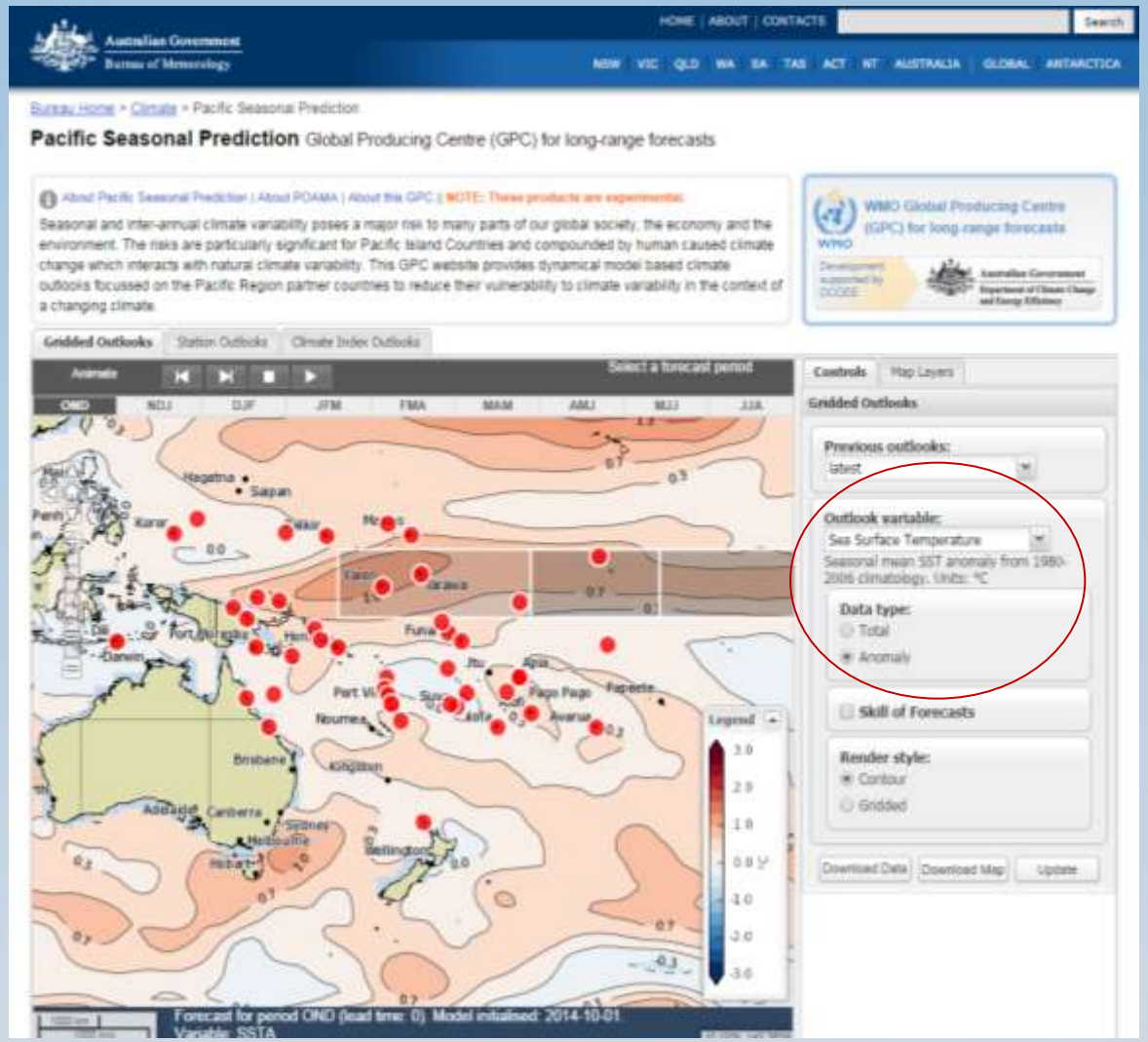
Navigating in Space (Map Navigation) and in Time

Controls to zoom in and out, and to display different regions.



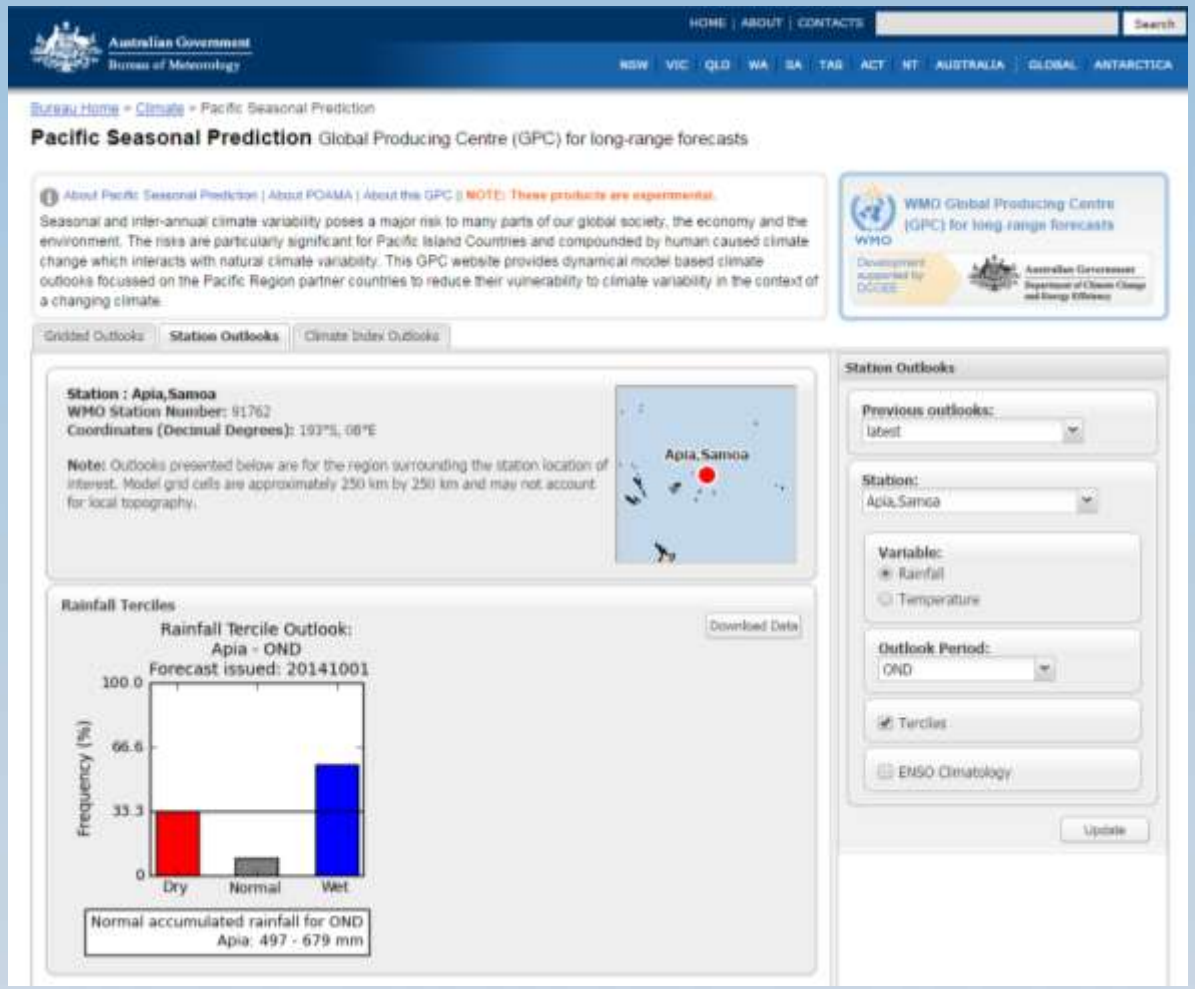
Controls to see the model maps for different month periods

Selecting Variables



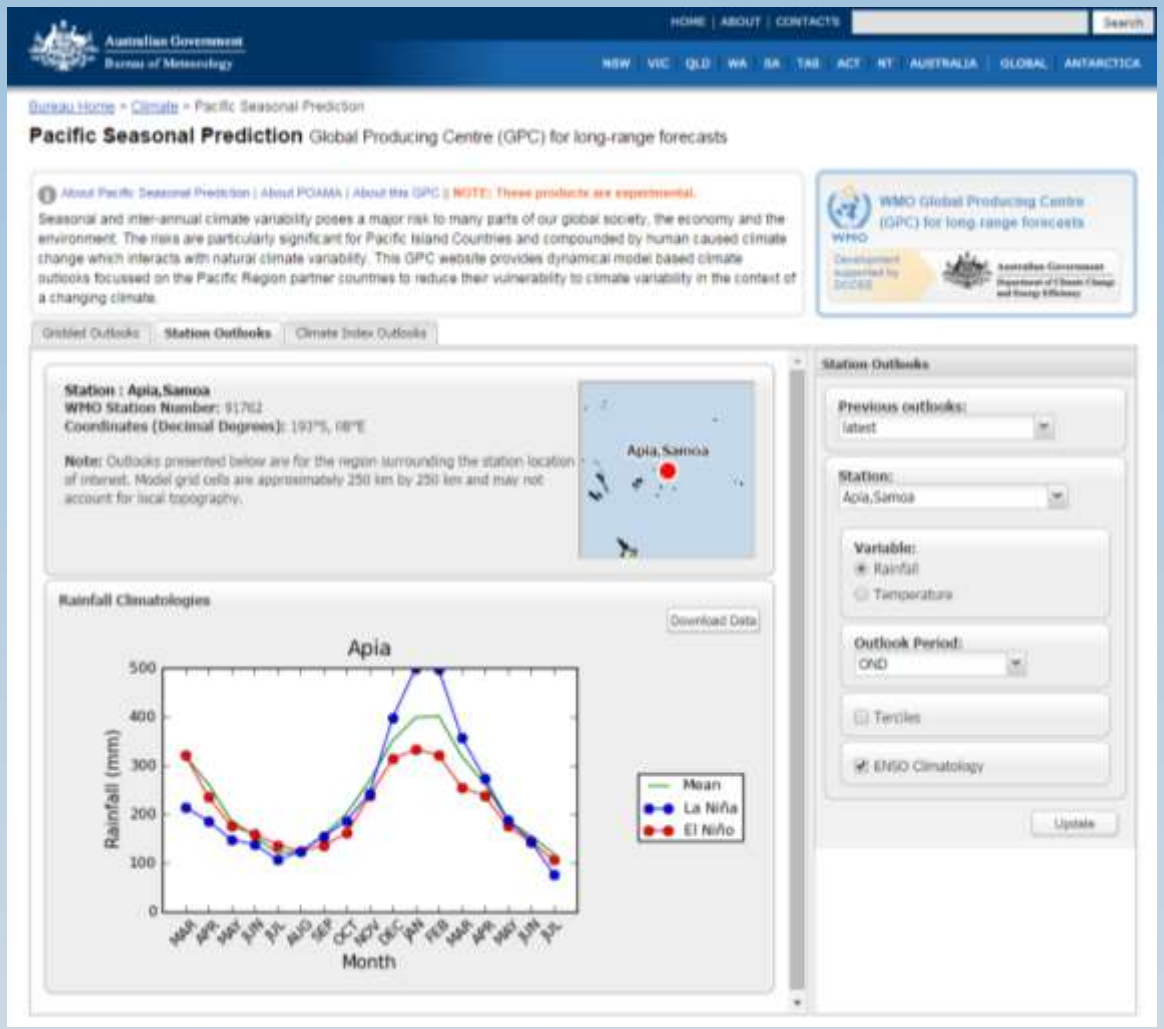
- Rainfall
- Temperature
- Mean Sea-Level Pressure
- Sea Surface Temperature

Site (Station) Outlooks



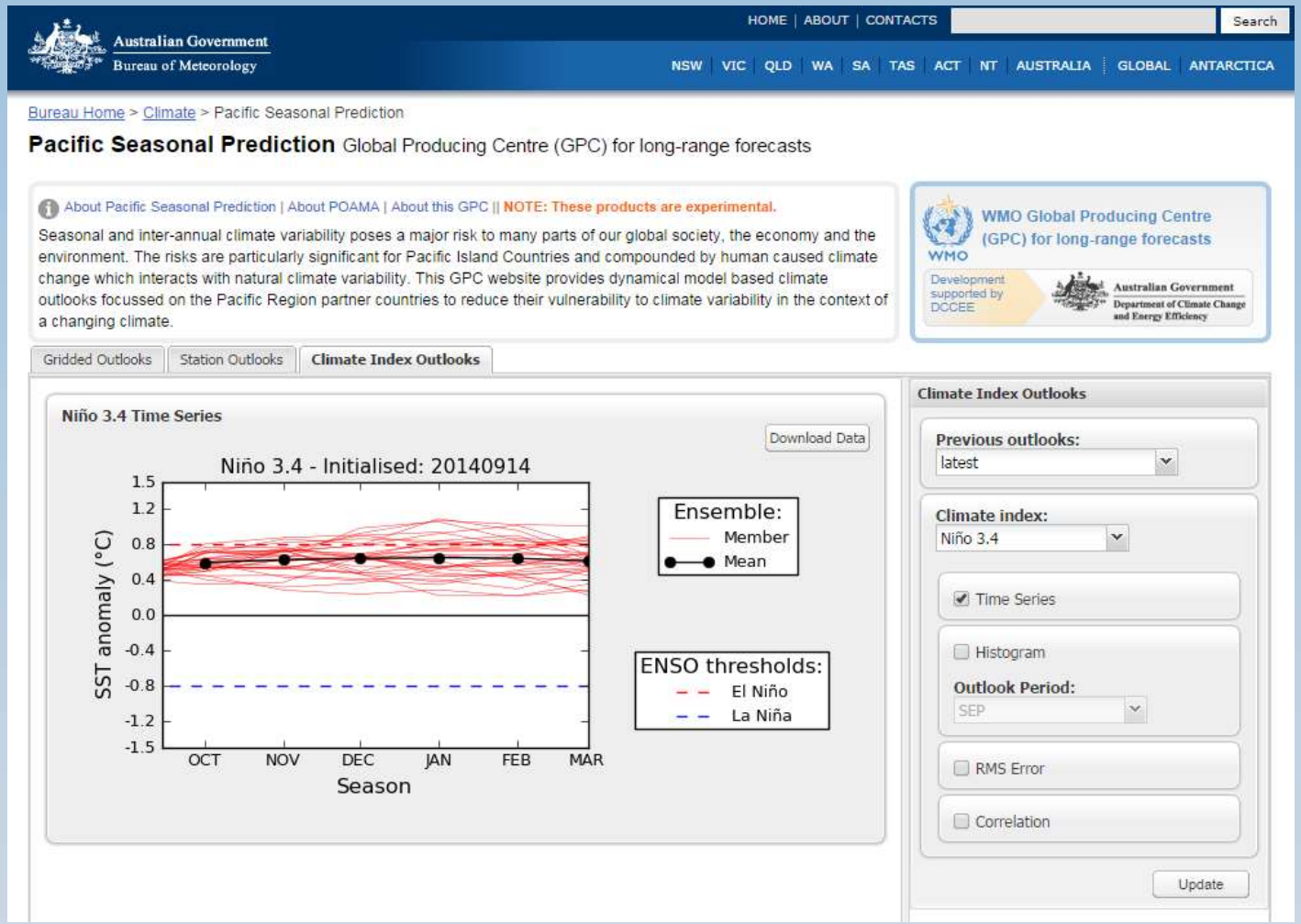
Site based (Apia, Samoa) tercile probability outlooks for rainfall

Site (Station) Outlooks - Climatology



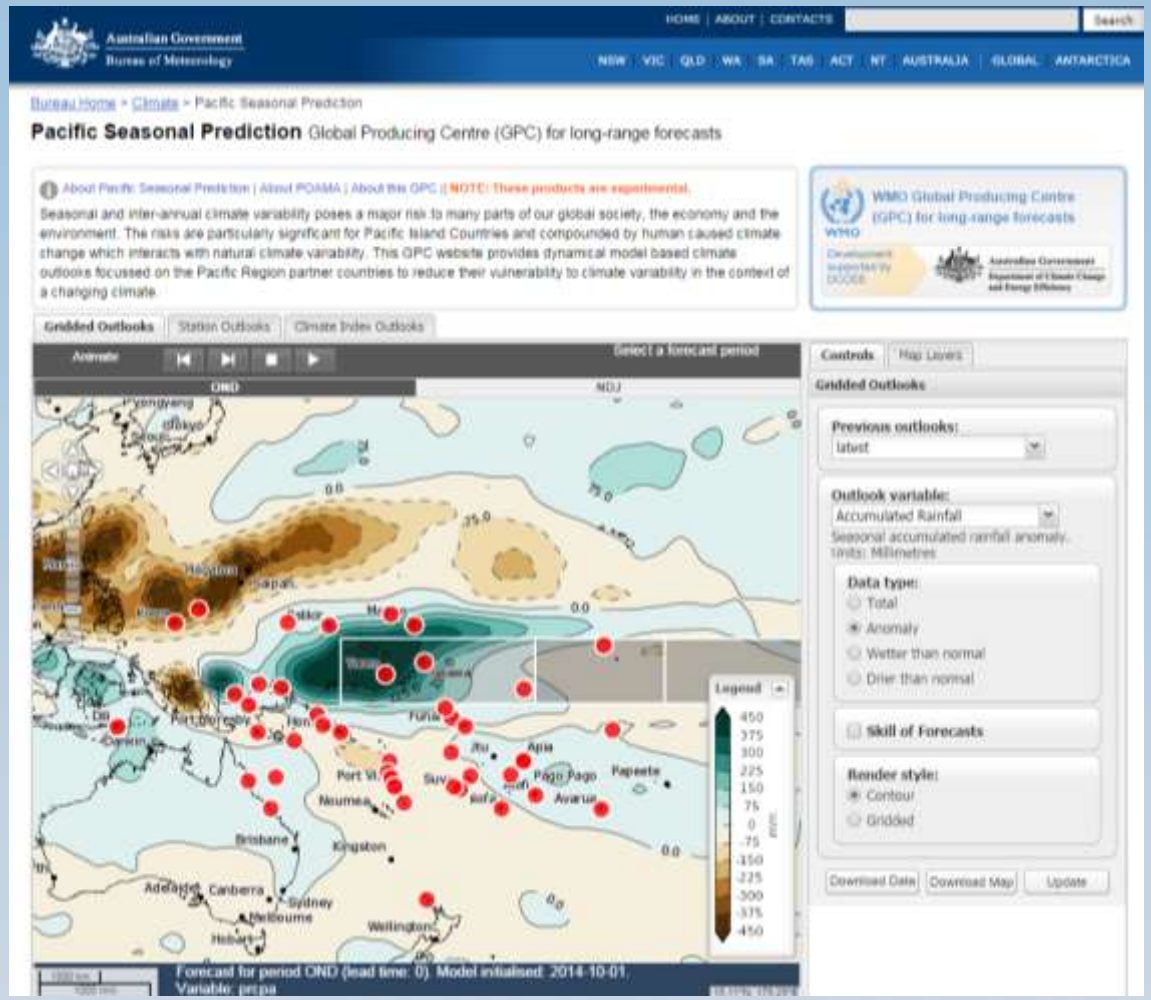
For certain sites, the historical rainfall for different phases of ENSO is provided.

Climate Index Outlooks



The ensemble of NINO3.4 temperature anomalies is displayed.

Rainfall



Accumulated rainfall over 3 month periods

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Capacity building

- Extensive training of the Pacific NMHS personnel during in-country visits
- PASAP, PCCSP and PACCSAP numerous workshops

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Conclusions

- The projected increase in the frequency of weather and climate extremes is one of the expected consequences of the observed increase in anthropogenic greenhouse gas concentration and will likely have even stronger negative impacts on the natural environment and society in the future.
- This should be taken into consideration by authorities of Pacific Island Countries and aid donors when developing strategies to adapt to the increasing risk of climate extremes.
- Here we demonstrated that the modern science of seasonal climate prediction is well developed, with current dynamical climate models being able to provide skilful predictions of regional rainfall two-three months in advance.

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Conclusions

- The dynamic climate model-based forecast products are now disseminated to the National Meteorological and Hydrological Services of 15 island countries in the Western Pacific through a range of web-based information tools.

- We conclude with confidence that seasonal climate prediction is an effective solution at the regional level to provide governments and local communities of island nations in the Western Pacific with valuable assistance for informed decision making in adaptation to climate variability and change.

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Thank you

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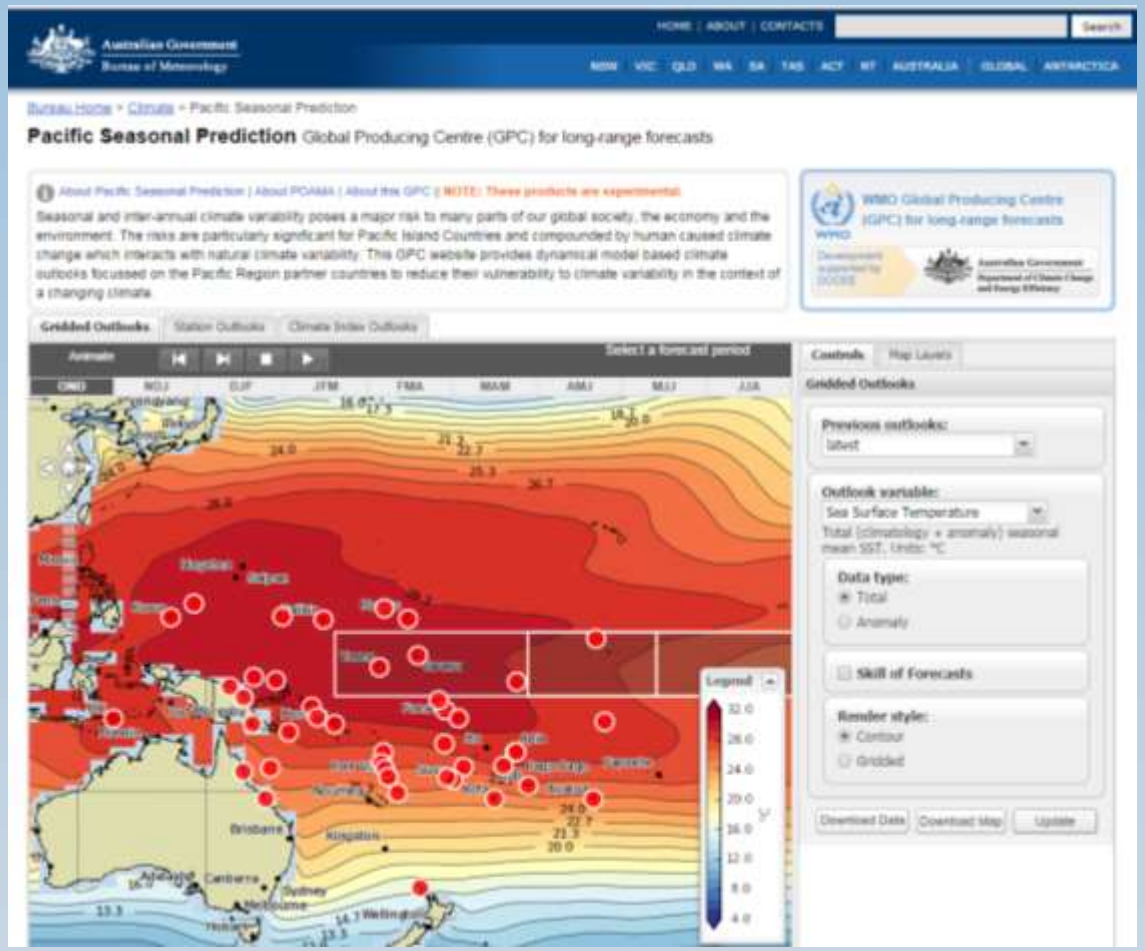
Sea Surface Temperature



Most models have their highest skill in predicting equatorial Pacific Sea Surface Temperature (SST)

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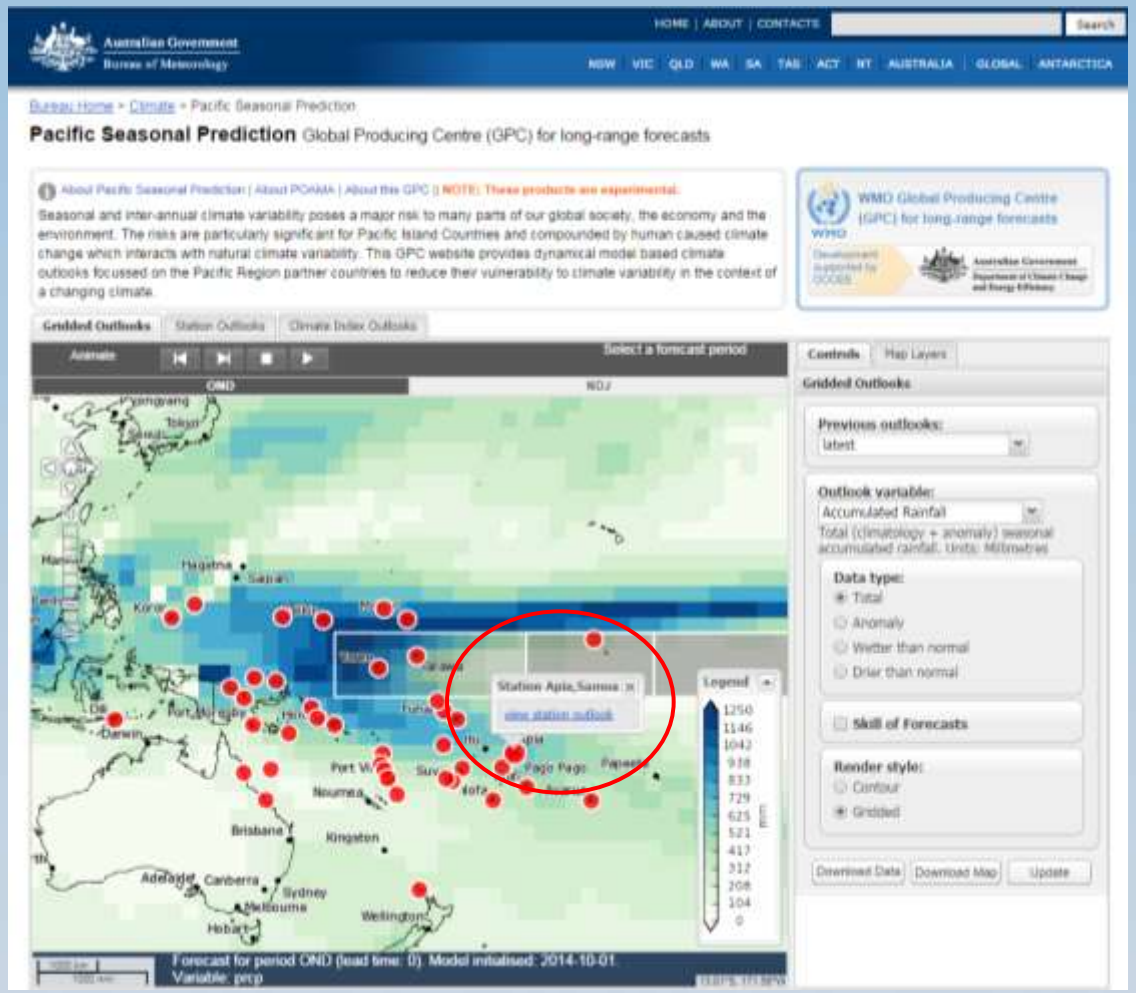
Site Outlooks



Select a site to bring up the outlook for that location