Australian Government
Bureau of Meteorology

COSPPac Ocean Portal
About: Seasonal Sea Surface Temperature Forecast

In Brief

Seasonal Sea Surface Temperature Forecasts *are issued monthly, out to six months ahead. Temperature forecasts in degrees Celsius are available in the "Fisheries" application (along with the location of the* ***convergence zone****). Anomalies are available in the "Coral Reefs" application.*

Seasonal forecasts differ from short term forecasts in that instead of predicting individual events on daily or weekly timescales, they show the average sea surface temperature signals over monthly periods.

Introduction

The temperature of the ocean varies at different locations, with seasonal sea surface temperature (SST) patterns often persisting for many months. In the Pacific Ocean, variability of SST is primarily linked with seasonal cycles (i.e. summer/winter) and the El Niño Southern Oscillation (ENSO). ENSO events have been associated with droughts, floods, changes in cyclone frequency and location, and occurrence of vector-borne diseases transmitted via mosquitos (such as malaria).

SST fluctuations can also have an effect on the coral reef marine ecosystems of the tropical Pacific. Coral bleaching is largely due to a sustained period of above average water temperatures. Degraded coral reefs present many potential social and economic problems for Pacific partners, including long-term loss of tourism, degradation of fisheries and reduction in coastal protection (Miles et al., 2014).

Seasonal sea surface temperatures forecasts for upcoming months are currently being produced using the Australian Bureau of Meteorology's ocean-atmosphere forecast model, ACCESS-S[1] (Hudson et al., 2017).

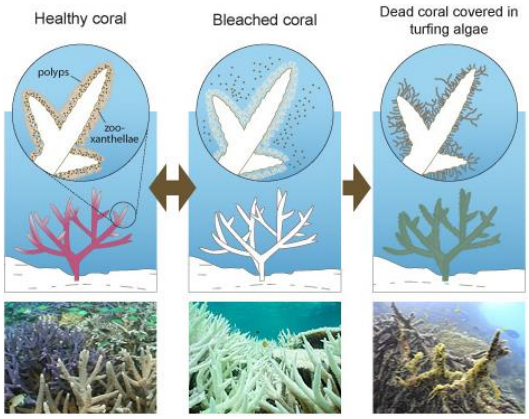

Figure 1. Coral bleaching process from healthy coral to bleached state that can result in coral mortality if conditions persist.

The Convergence Zone

For the scale of the Pacific basin, relative abundance of Skipjack tuna is well correlated with the movement of the convergence zone (Lehodey et al., 1997) where large predators like tuna gather due to the presence of plankton and micronekton. The convergence zone is a well-defined salinity front that surrounds the western Pacific warm pool. The 29 °C isotherm around the western Pacific warm pool forms a good proxy for the convergence zone, and can therefore be used to track the gravity centre of Skipjack tuna fishing activity in the east/west direction during ENSO phases.

[1] ACCESS-S: Australian Community Climate Earth-System Simulator - Seasonal

Skill of Forecast

The accuracy of the seasonal forecast is dependent on location and how far into the future the forecast is targeting, known as the lead-time. To determine model skill, the model is run retrospectively (in the past) and compared to satellite observations of SST during that time. A lead time of 0 corresponds to the month following model initialisation, and a lead time of 1 is the next month after that, and so on.

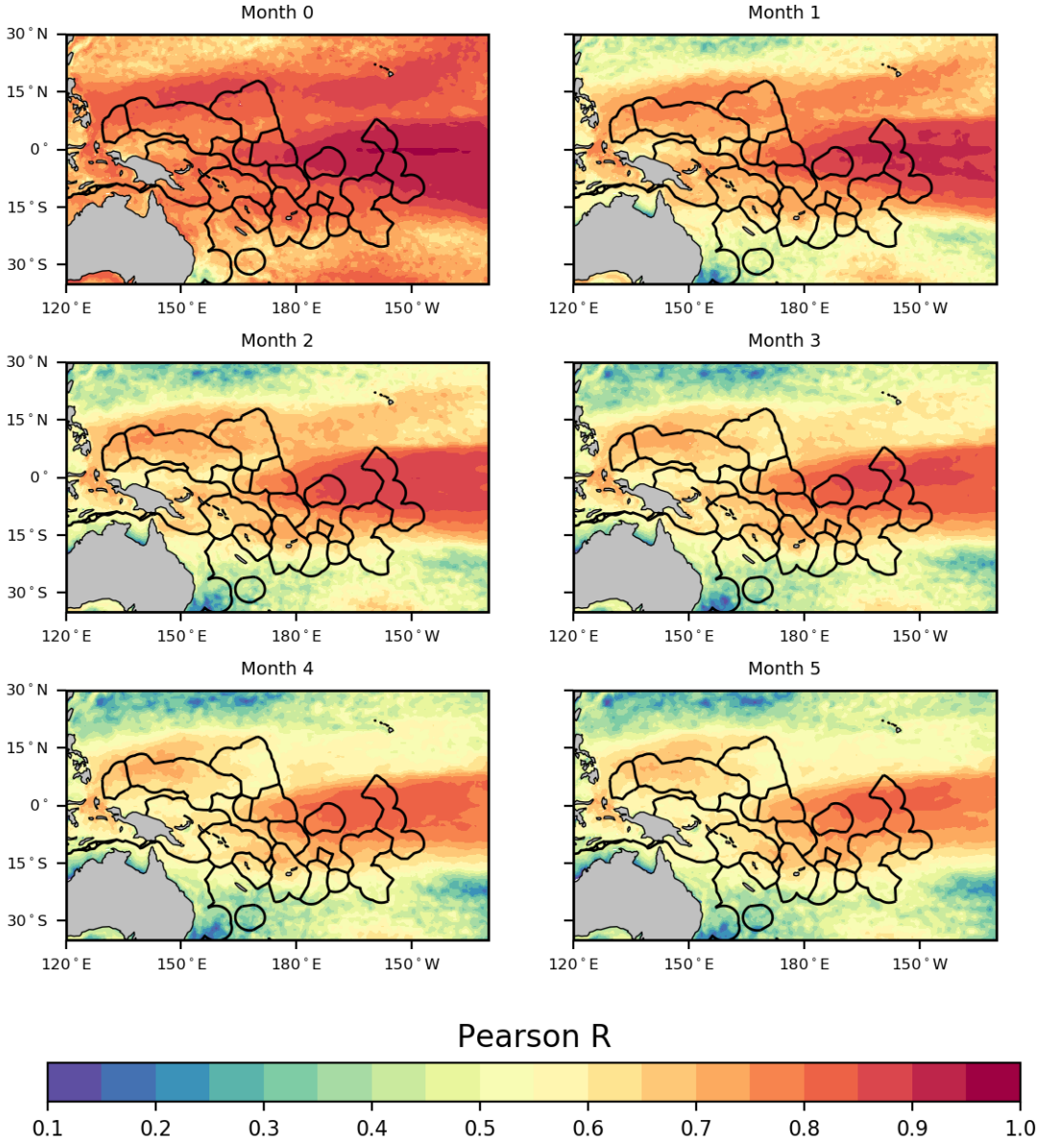

Figure 2. Skill of ACCESS-S SST summarised across the year for different lead times. Observations for comparison were the OISSTv2 product.

Model skill is acceptable where the Pearson correlation Coefficient is statistically significant, in this case being the value of 0.1 or greater. Skill is highest across tropical Pacific, most likely due to skill related to capturing the El Niño Southern Oscillation (ENSO) signal. The skill reduces for longer forecasts, however it is acceptable over all west to south west Pacific island countries out to six months.

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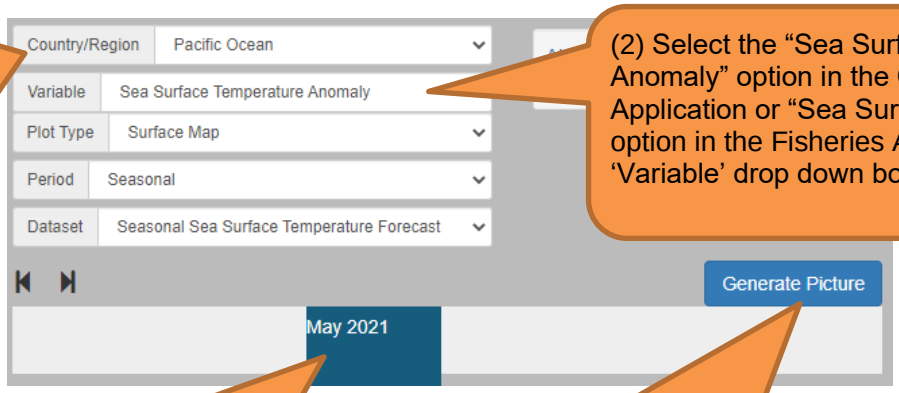
Using the Portal



(1) For a regional view of a Pacific Nation's EEZ, select the country's name from this drop down box.

(2) Select the "Sea Surface Temperature Anomaly" option in the Coral Reefs Application or "Sea Surface Temperature" option in the Fisheries Application using the 'Variable' drop down box.

(3) The slider at the bottom lets you select the monthly period for the forecast information.

(4) Click the 'Generate Picture' button to create a map that you can download to insert into documents, presentations, etc.

Description of Parameters

Sea Surface Temperature (SST):

Temperature is shown in degrees Celsius and forecast out to six months ahead. Dataset is located in the "Fisheries" application. The convergence zone (represented by the 29°C contour) is shown over the SST map along with the position for where the convergence zone is typically located for a given month.

Sea Surface Temperature Anomaly (SSTA):

A seasonal SSTA forecast anomaly shows how the temperature is different from the long-term average. The map shows locations of both higher and lower temperatures, indicated by positive and negative numbers. Units are in degrees Celsius and forecast out to six months ahead. The seasonal SST forecasts are created by comparing the model predictions of SST in the coming months with the long-term averages using the model hindcast period 1981 to 2018. The dataset is located in the "Coral Reefs" application.

Examples of Applications

- **Fisheries:** Stakeholders in the fisheries sector can compare the forecast position of the convergence zone with its typical location for any given month to aid in decision making regarding upcoming tuna stocks. This is of particular interest for countries in the far west or east of the south west Pacific that experience drift of the convergence zone in and out of their exclusive economic zones during ENSO events.

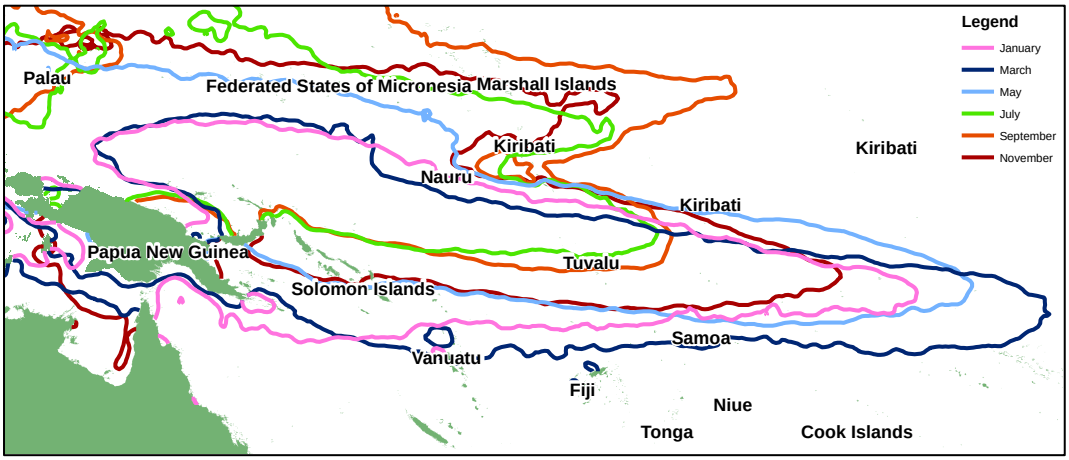


Figure 3. Typical location of the convergence zone throughout the year

- **ENSO:** SST is one of the key indicators of the El Niño Southern Oscillation. Long-lead seasonal SST forecasts provide us with possible scenarios for the evolution of ENSO within the indicator regions shown in Figure 4.

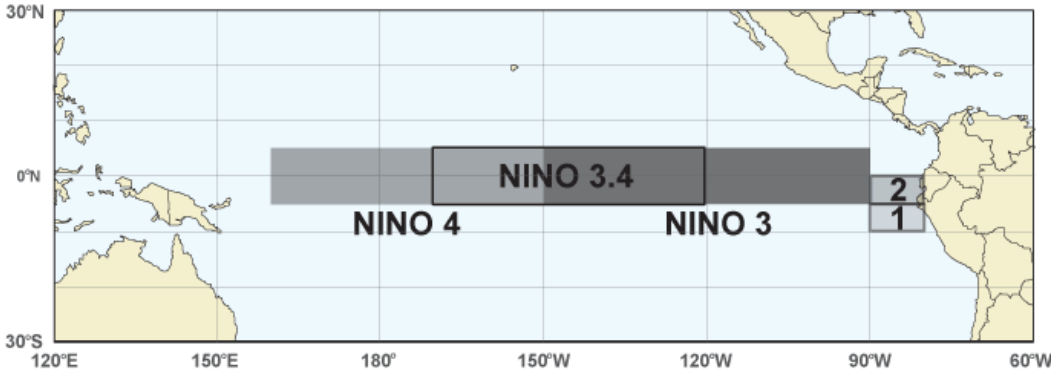


Figure 4. The NINO boxes are the areas of interest when observing anomalous SST as indicators of ENSO events.

- **Climate:** Processes in the atmosphere and ocean are connected. Ocean temperature influences rainfall patterns around the world. Rainfall amounts can be anticipated by monitoring patches of warmer and cooler anomalies. Warmer SSTs in the tropics are often associated with increased rainfall.

- **Cyclones:** The formation of tropical cyclones requires SSTs higher than 26.5 degrees Celsius, although major storms require higher temperatures (Webster et al., 2006). Monitoring warm patches of ocean gives insight into the potential for cyclone formation, and the possible start or finish of the cyclone season.

- **Coral Bleaching:** Along with the Coral Bleaching Forecasts that are based on the NCEP CFSv2 model, ACCESS-S provides another source of information that can be used to confirm the likelihood of bleaching events by monitoring high SST anomalies.

Data Source

The forecasts are generated using the Australian Bureau of Meteorology's seasonal model ACCESS-S. It is a state-of-the-art dynamical (physics-based) forecast modelling system, which uses ocean, atmosphere, ice and land observations to initiate outlooks for the season ahead. The ACCESS–S

climate model is a collaboration between the Bureau of Meteorology and the UK Meteorological Office (UKMO).

The ocean model component of ACCESS–S operates at an approximate resolution of 25 km in the Pacific region. At this resolution, the model can resolve small-scale currents and eddies. ACCESS-S outlooks are based on a 99-member ensemble. This is a common climate forecasting technique where the model is run 99 times with slightly different initial conditions to capture a range of likely future scenarios.

ACCESS-S replaced POAMA in August 2018. POAMA, also a dynamical climate model, was used for official Bureau climate outlooks from May 2013 until ACCESS–S was brought into operation.

Links

Further information about the Bureau of Meteorology Seasonal Model ACCESS-S

http://www.bom.gov.au/climate/ahead/about/model/access.shtml

NOAA's Climate Forecast System Version 2 SST Monthly Pacific Outlook

https://www.cpc.ncep.noaa.gov/products/people/wwang/cfsv2fcst/images3/PacSSTSeaadj.gif

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References

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