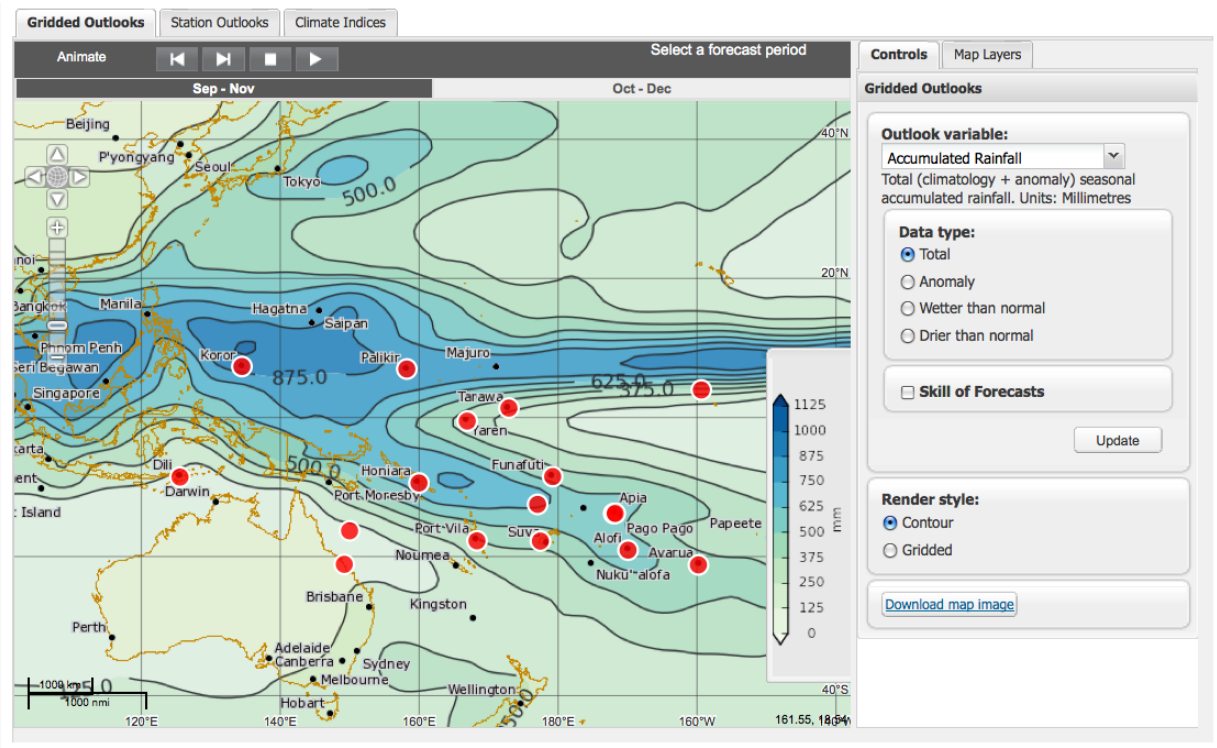
PASAP Seasonal Prediction Portal User Manual

Part 2: Forecast Guide

This document contains concise descriptions of the seasonal outlooks available through the PASAP seasonal prediction portal.

The document is divided into several sections. The first consists of descriptions of the various **Seasonal Outlooks** available in the portal. **Concepts and Procedures** is a glossary of technical terms that will appear elsewhere in this document and on the portal. **Verification Scores** contains descriptions of the various skill scores presented in the portal.



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Section 1: Seasonal Outlooks

Gridded Outlooks

The Predictive Ocean Atmosphere Model for Australia (POAMA) provides forecast data on a latitude/longitude grid of ~2.5° × ~2.5°. Data are shown in the portal for the area 70° S to 70° N. Missing data are present in some data types for rainfall due to missing data in the observed climatology used for comparison.

Caution is urged when interpreting grid scale features. Emphasis should be placed on broad scale patterns that encompass several grid points, i.e. features that have scales >5° or approximately 500 km.

Inflation of variance is applied to the ensemble members for the outlook variables seasonal rainfall and surface air temperature. This corrects for systematic biases in the model by adjusting the model predictions according to hindcast skill for the season and location. This calibration procedure is explained in section 2.

Outlook generation process

Input data: Monthly 30-member ensemble data out to 9 months.

1. Calculate 3-month sequential seasonal means (e.g. JFM, FMA, MAM, AMJ, etc.) for each ensemble member.
2. Calculate seasonal-mean anomalies for each ensemble member by removing model hindcast climatology.
3. If inflation of variance is applied, perform this operation on all ensemble members.
4. Calculate ensemble mean, i.e. arithmetic mean of all ensemble members (using the variance inflated ensemble members if appropriate).
5. Calculate total field by adding the observed climatology to the ensemble-mean anomaly (to the variance inflated ensemble-mean if appropriate).
6. If appropriate, calculate tercile probability by determining the percentage of ensemble members in the upper and lower terciles, using upper and lower tercile thresholds computed from model hindcast.

Description of outlook variables:

Accumulated Rainfall (Variance Inflated)

Seasonal forecasts of accumulated rainfall are provided at 0 and 1 lead times, i.e. for the two 3-month periods beginning with the current month and the subsequent month.

Data type: Total
Short description: Total seasonal accumulated rainfall. Units: Millimetres
Full description: Seasonal forecast of accumulated rainfall, in millimetres. The total field shown represents the amount of rainfall that will accumulate over the 3-month period.

Data type: Anomaly
Short description: Seasonal accumulated rainfall anomaly from 1980-2006 climatology. Units: Millimetres
Full description: Seasonal forecast of accumulated rainfall anomaly, in millimetres. The anomaly field shown represents the ensemble mean forecast amount of rainfall that will accumulate over the 3-month period as an anomaly (or deviation) from the long-term climatological value for the period 1980-2006 based on CMAP (CPC Merged Analysis of Precipitation) observations.

Data type: Wetter than normal
Short description: Probability of rainfall amount in the upper climatological tercile. Range: 0 to 100. Units: %

Full description: Probability that the forecast seasonal accumulated rainfall will be in the upper climatological tercile, in %. This quantity represents the likelihood that wetter than normal conditions will prevail for the 3-month period shown, where normal is defined using the 1980-2006 CMAP climatology.

Data type: Drier than normal
Short description: Probability of rainfall amount in the lower climatological tercile. Range: 0 to 100. Units: %
Full description: Probability that the forecast seasonal accumulated rainfall will be in the lower climatological tercile, in %. This quantity represents the likelihood that drier than normal conditions will prevail for the 3-month period shown, where normal is defined using the 1980-2006 CMAP climatology.

Surface Air Temperature (Variance Inflated)

Seasonal forecasts of surface air temperature are provided at lead times of 0 and 1 month, i.e. for the two 3-month periods beginning with the current month and the subsequent month.

Data type: Total
Short description: Seasonal mean surface air temperature. Units: °C
Full description: Forecast of seasonal-mean air temperature at 1.5 m, in °C. The total field shown represents the ensemble mean forecast average air temperature near the surface for the 3-month period.

Data type: Anomaly
Short description: Seasonal mean surface air temperature anomaly from 1980-2006 climatology. Units: °C
Full description: Forecast of seasonal-mean air temperature anomaly at 1.5 m, in °C. The anomaly field shown represents the ensemble mean forecast near-surface air temperature averaged over the 3-month period as an anomaly (or deviation) from the long-term climatological value for the period 1980-2006 based on the NCEP II 2 m air temperature reanalysis.

Data type: Warmer than normal
Short description: Probability of temperature amount in the upper climatological tercile. Range: 0 to 100. Units: %
Full description: Probability that the forecast seasonal-mean air temperature at 1.5 m will be in the upper climatological tercile, in %. This quantity represents the likelihood that warmer than normal conditions will prevail for the 3-month period shown, where normal is defined using the 1980-2006 NCEP II 2 m air temperature climatology.

Data type: Cooler than normal
Short description: Probability of temperature amount in the lower climatological tercile. Range: 0 to 100. Units: %
Full description: Probability that the forecast seasonal-mean air temperature at 1.5 m will be in the lower climatological tercile, in %. This quantity represents the likelihood that cooler than normal conditions will prevail for the 3-month period shown, where normal is defined using the 1980-2006 NCEP II 2 m air temperature climatology.

Mean Sea Level Pressure (MSLP)

Seasonal forecasts of MSLP are provided at 6 lead times, i.e. for the six 3-month periods beginning with the current month and the subsequent 5 months.

Data type: Total
Short description: Seasonal mean MSLP. Units: hPa.
Full description: Forecast of seasonal-mean MSLP, in hPa. The total field shown represents the ensemble mean forecast average MSLP for the 3-month period.

Data type: Anomaly
Short description Seasonal mean MSLP anomaly from 1980-2006 climatology. Units: hPa.
Full description: Forecast of seasonal-mean MSLP anomaly, in hPa. The anomaly field shown represents the ensemble mean forecast MSLP averaged over the 3-month period as an anomaly (or deviation) from the long-term climatological value for the period 1980-2006 based on the NCEP II MSLP reanalysis.

Sea Surface Temperature (SST)

Seasonal forecasts of SST are provided at 6 lead times, i.e. for the six 3-month periods beginning with the current moth and subsequent five months.

Data type: Total
Short description: Seasonal mean SST. Units: °C.
Full description: Forecast of seasonal-mean SST in °C. The total field shown represents the ensemble mean forecast average SST for the 3-month period.

Data type: Anomaly
Short description Seasonal mean SST anomaly from 1980-2006 climatology. Units: °C.
Full description: Forecast of seasonal-mean SST anomaly, in °C. The anomaly field shown represents the ensemble mean forecast SST averaged over the 3-month period as an anomaly (or deviation) from the long-term climatological value for the period 1980-2006 based on the HadISST dataset.

Climate Indices

Seasonal forecasts of the phase of El Niño-Southern Oscillation (ENSO) are provided based on the POAMA ensemble. The phase of ENSO is determined using indices based on SST anomalies over certain regions of the tropical Pacific Ocean. Forecasts are shown for selected indices as follows:

NINO3

Index area: (5° S – 5° N, 90° – 150° W)

Index description: Central/Eastern Pacific index. This region exhibits the largest variability in SSTs on El Niño timescales.

NINO3.4

Index area: (5° S – 5° N, 160° E – 150° W)

Index description: Central Pacific index. This region approximately combines the important facets of the NINO 3 and 4 regions into one index.

NINO4

Index area: (5° S – 5° N, 120° – 170° W)

Index description: Western/Central Pacific index. The SSTs in this region fluctuate about a mean temperature of 27.5°C, a temperature threshold which is important for the generation of rain-producing cumulus/cumulonimbus clouds.

SST anomaly generation process

For each index:

1. Calculate area-average SST value for each ensemble member.
2. Remove the area-average model hindcast climatological SST value.
3. Calculate the ensemble mean anomaly from the ensemble members.

Plot types

The information contained within the seasonal forecasts for the each of the climate indices is displayed in several ways. A description of these methods along with a brief discussion on how the plots should be interpreted is provided below.

Plot: Time Series
Description: Time series of seasonal SST anomaly forecasts based on the ensemble. The ensemble mean and the individual ensemble members are shown. This time series is composed of seasonal

forecasts for seven lead times, i.e. the 3-month periods beginning with the current month and subsequent six months.
Interpretation: The ensemble mean is provided to give a consensus view or a best estimate of the seasonal SST anomaly forecast. The confidence in this best estimate forecast is represented by the spread of the members about the mean.

Plot: Time Series
Description: Time series of seasonal SST anomaly forecasts based on the ensemble. The ensemble mean and the quartiles (the $25^{th}$and 75^{th} percentiles) are shown. Time series is composed of seasonal forecasts for seven lead times, i.e. the 3-month periods beginning with the current month and subsequent six months.
Interpretation: The ensemble mean is provided to give a consensus view or a best estimate of the seasonal SST anomaly forecast. The confidence in this best estimate forecast is represented by the quartiles. These provide a measure of the spread of the ensemble about the mean, 50% of the ensemble members lie in the range between the upper and lower quartiles. Therefore, quartiles that are close to the ensemble mean imply a higher confidence in the ensemble mean forecast.

Plot: Histogram
Description: Seasonal forecast of the probability of ENSO phase based on the ensemble. Probability histograms are available for seven lead times, i.e. for the 3-month periods beginning with the current month and the subsequent six months.
Interpretation: The likelihood that a phase of ENSO may occur based on the number of members of the ensemble exceeding the seasonal SST anomaly thresholds for El Niño or La Niña. The thresholds for El Niño and La Niña are set at 0.8°C anomaly for the 3-month seasonal forecasts.

Station Outlooks

Seasonal forecasts of temperature and rainfall are provided for each station using 20 members of the ensemble. The data from the POAMA grid are interpolated to the actual station location. Climatological data for each station is also provided for comparison with the forecasts.

Forecast variables

Data type: Rainfall Tercile Probabilities - **Station Calibrated [In development]**
Description: The probability of wetter or drier than normal, or normal, conditions based on the 20-member ensemble. These data are calibrated using station-based rainfall observations. Seasonal forecasts are available for the 3-month periods beginning with the current month and the subsequent month.

Data type: Rainfall Tercile Probabilities - **Grid Calibrated**
Description: The probability of wetter or drier than normal, or normal, conditions based on the 20-member ensemble. These data are calibrated using gridded rainfall observations. Seasonal forecasts are available for the 3-month periods beginning with the current month and the subsequent month. Because this forecast represents rainfall over a large spatial area, differences in local rainfall due to topography need to be taken into account when applying the forecast locally.

Data type: Mean Temperature Tercile Probabilities
Description: The probability of warmer or cooler than normal, or normal, conditions based on the 20-member ensemble. Seasonal forecasts are available for the 3-month periods beginning with the current month and the subsequent month.

Climatological variables

Data type: Station rainfall climatology
Description: Monthly rainfall climatology, in millimetres, from station observations. Climatology is for the 1980-2008 period.

Data type: Station ENSO composites
Description: Monthly rainfall climatology for the winter and summer following either an El Niño or La Niña event, in millimetres. Climatologies use station observations. The El Niño composite climatology uses

mean monthly rainfall for four El Niño years (1982-83, 1986-87, 1987-88 and 1997-98) and four Modoki years (1991-92, 1994-95, 2002-03 and 2004-05). El Niño and Modoki years are amalgamated into a single ENSO composite to represent all El Niño like years. The La Niña composite climatology uses mean monthly rainfall for four La Niña years (1984-85, 1988-89, 1998-99 and 1999-2000).

Section 2: Concepts and Procedures

Coupled Model / GCM

A Global Climate Model (GCM) that is coupled and incorporates both an atmospheric model and an oceanic model. These two components of the coupled model are allowed to interact with each other allowing the atmosphere-ocean system to be simulated and predicted. POAMA is a coupled model.

Ensemble

An ensemble is a collection of forecasts where each member of the ensemble (each individual forecast) is produced by running the same model with slightly different initial conditions. The POAMA forecasts described here are generated from an ensemble of 25 members.

Ensemble Frequency / Probability

The likelihood that a particular forecast will be realised can be assessed using an ensemble of forecasts. The spread of the ensemble members about the ensemble mean provides a measure of the range of possible outcomes forecast by the model. For POAMA, the ensemble mean is calculated from the 25 members and the probability thresholds are calculated using the 10 members from the hindcast climatology.

Climatology

The climatology of a variable (e.g. temperature or rainfall) is a long-term average of that variable. Two types of climatologies are used in the PASAP Seasonal Predictions: observed climatologies and model climatologies. The observed climatologies of each variable are produced from relevant observational data for the period 1980-2006. Model climatologies are produced using POAMA for the same time period, referred to as a hindcast climatology.

Anomaly

An anomaly refers to the deviation or departure from the normal or average of a variable (e.g. rainfall or sea surface temperature). A large anomaly value implies a large departure from the average value. In the current context, forecast anomalies are calculated as deviations from the model hindcast climatology.

Total

In a meteorological context, the “total” of a variable is the actual forecast or observation of that variable. The total can be broken down into the climatological mean and the departure from that mean. For PASAP Seasonal Prediction, forecasts of variables are provided in two forms: the total field and the anomaly field. The total fields are calculated by combining the model anomaly field of a variable (described above) with the observed climatology of that variable.

Calibration (Inflation of Variance)

This is a numerical method which adjusts the variance and spread of model data (such as rainfall) to match statistics from observations at a particular station or point. Typically this adjustment or calibration of the model data retains the same correlation between the observations and model data before and after the calibration.

Tercile

The lower and upper tercile values are the two points that divide an ordered distribution into three parts of equal dimensions. The middle (second) tercile is considered to be “normal” conditions.

Section 3: Verification Scores

Correlation

The correlation is a measure of the strength of the linear relationship between two quantities. No relationship exists between two quantities if the correlation is 0; correlation values of 1 and -1 indicate a perfect positive and negative relationship, respectively. The correlation for each variable (e.g. temperature or rainfall) is determined by comparing the POAMA hindcast time series to the observed time series.

RMS Error

The root mean square error (RMSE) is used to measure the difference between values predicted by a model and the values actually observed. A lower RMSE value indicates a better measure of precision and a smaller difference between predicted and observed values. The RMSE for each variable (e.g. rainfall or sea surface temperature) is determined by comparing the POAMA hindcast climatology to the observed climatology.

Hit Rate

The hit rate (sometimes referred to as probability of detection) is a measure of forecast skill in a model; it gives the fraction of observed events that were correctly forecast. Hit rate is calculated as the ratio of correct forecasts to the number of times this event occurred. In the current context, hit rates are calculated for temperature and rainfall tercile forecasts.