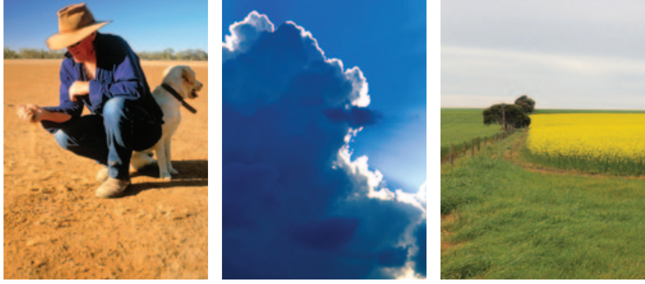
South Eastern Australian
Climate Initiative



Predicting seasonal climate and streamflow

Seasonal climate drivers

Rainfall prediction across south-eastern Australia relies upon an understanding of how various large-scale climate factors affect rainfall patterns across the region. Prediction of seasonal rainfall across the region is derived from strong associations with El Niño – Southern Oscillation (ENSO), the Indian Ocean Dipole (IOD) and the Southern Annular Mode (SAM).

The impact of the ENSO and IOD on rainfall is relatively well understood and provides a degree of confidence when developing seasonal predictions. The SAM however, has a shorter time scale than that of the ENSO and the IOD, and therefore its contribution to forecast skill only tends to occur in the first month of the forecast.

Regional variations in the nature of impacts from these large-scale factors must also be taken into account when developing predictions for south-eastern Australia. For example, the IOD mainly affects the southern part of the Murray–Darling Basin (MDB) from mid-winter to mid-spring. However, El Niño events that have their largest amplitude in the eastern Pacific Ocean tend to reduce rainfall in the southern MDB in late spring to early summer. By comparison, El Niño events that have their largest amplitude in the central Pacific Ocean tend to reduce rainfall in the northern MDB in late autumn to winter.

Progress with seasonal climate prediction

POAMA2, the new coupled ocean–atmosphere seasonal forecast system, is routinely run at the Bureau of Meteorology to forecast seasonal climate with lead times of up to nine months. The new POAMA2 system can now predict the occurrence of El Niño events up to nine months in advance, though predictability of IOD events is still limited to lead times of less than three months.

POAMA2 successfully translates the good predictions of El Niño and IOD into high quality predictions of rainfall in south-eastern Australia at three-month lead times. For instance, the likelihood of receiving above average rainfall across south-eastern Australia during winter and spring is correctly predicted between 55% and 70% of the time for lead times of three months.

A good forecast from POAMA2 was made for the record wet spring in 2010 (Figure 1). This rainfall forecast was a result of POAMA2 correctly predicting the strong La Niña conditions in the Pacific Ocean at a six-month lead time which, together with a negative IOD and a very strong positive SAM, contributed to large rainfall accumulations across most of Australia.

(a) observed *(b) forecast*

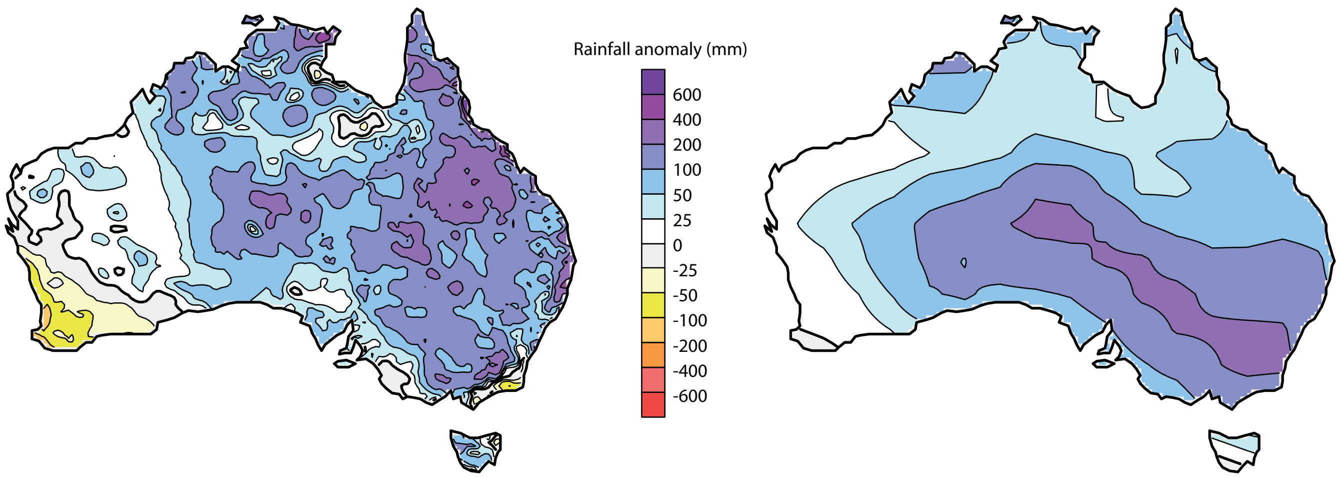


Figure 1. (a) Observed and (b) forecast rainfall anomalies for spring season 2010. The forecast is the POAMA2 seasonal forecast that was initialized on 1 September 2010 and provided a good forecast of observed conditions (Bureau of Meteorology)

SEACI is a partnership between the CSIRO Water for a Healthy Country Flagship, the Bureau of Meteorology, the Murray–Darling Basin Authority, the Victorian Department of Sustainability and Environment, and the Australian Government Department of Climate Change and Energy Efficiency.

Research in Phase 2 of SEACI indicates that there are good prospects for improving the prediction of seasonal rainfall at longer lead times. Currently, systematic model biases are preventing the predictions of El Niño and the IOD from being properly translated into good rainfall predictions at lead times greater than three months. These model biases have been identified and are being addressed for the next version of POAMA.

Progress with seasonal streamflow forecasting

Skilful forecasting of seasonal streamflow for south-eastern Australia is dependent upon two sources of predictability. The dominant source is knowledge of the condition of the catchment soil and groundwater storages at the initial forecast date. Knowledge of climate variations during the forecast period – principally rainfall accumulation – is the other key source of predictability.

Statistical forecasts of streamflow can be made using antecedent streamflow (if available) or antecedent rainfall totals (in the absence of streamflow observations in near real-time) to represent the initial catchment soil and groundwater storage conditions. Rainfall variations for the forecast period are then inferred from some key climate indices at the initial forecast time.

The use of monthly water-balance model simulations to represent the initial catchment conditions has, on average, had little impact on forecast skill. Using these simulations does however reduce the chances of skill estimates based on forecasts of historical events being artificially inflated by predictor selection, and also reduces the computation requirements to establish forecasting models.

Replacing selected climate indices at the initial forecast time with rainfall forecasts from POAMA2 produces mixed results: the skill of streamflow forecasts increases in some seasons and decreases in others. The skill of these streamflow forecasts is related to the accuracy of the POAMA2 rainfall forecasts. Using all methods, the forecast probability distributions are reliable for all seasons with the exception of autumn, where to date no predictors have adequately described the impact of the rainfall decline since the mid-1990s.

The findings from this research are being used to improve the Bureau of Meteorology's operational seasonal streamflow forecasting service. An example forecast is shown in Figure 2. Here, historical conditions suggested that the streamflow for the three months from July to September 2009 could fall within a large range of conditions. The forecast however suggested that streamflow would be quite low, which was what in fact was observed, with flows just over 400 GL.

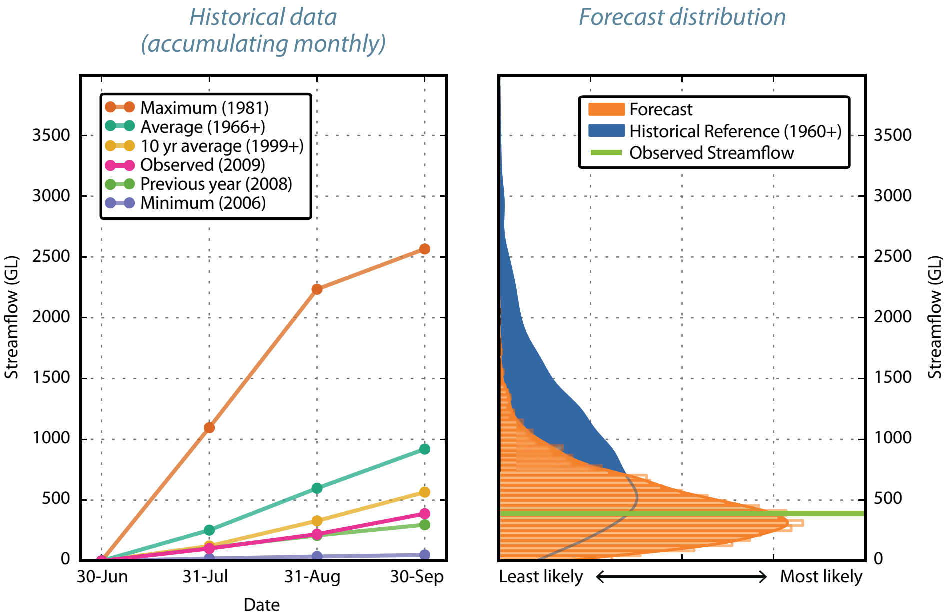


Figure 2. Seasonal streamflow forecast issued by the Bureau of Meteorology in July 2009 for total flows of the Ovens River to the Murray River for July to September 2009 (Bureau of Meteorology)

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Department of Climate Change and Energy Efficiency
Bureau of Meteorology

MURRAY–DARLING BASIN AUTHORITY

State Government Victoria Department of Sustainability and Environment

FACTSHEET 3 OF 4

The suite of four factsheets is available from www.seaci.org or by emailing seaci@csiro.au