IMPROVED CLIMATE FORECASTS FOR AUSTRALIA'S WOOL PRODUCERS

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INTRODUCTION

In order to minimise resource damage and enhance long-term productivity, pastoralists need improved seasonal forecasting knowledge and tools to better manage for the high climate variability that characterises Australia's rangelands. Issues affecting adoption of seasonal climate forecast (SCF) information include a (real or perceived) lack of regionally specific forecasts at times when key management decisions have to be made, and limited confidence in existing operational systems. Rather than seeking to identify forecasts that matched the existing timing of decisions, the initial approach adopted in this multi-state project funded by Land, Water and Wool (LWW) was to establish a system to test if and when SCF systems have skill in the major pastoral regions of Australia. Four State-based projects then investigate the extent to which wool producers could take advantage of this climate forecast information in management decisions (see posters by Alemseged *et al.* and Watson, this conference). This approach has the advantage of addressing to some extent the risk of 'unrealistic expectations' on the part of producers and uses the flexibility that exists in pastoral enterprises, particularly in terms of managing stock numbers. However, it does not address the lack of a clear link between operational SCF systems and publicly available reports on probability of an El Niño or La Niña developing. Therefore, a second approach using recent understanding of the relationship between indices of Pacific Ocean oscillations and climate variability in Australian rangelands is also being evaluated for potential to deliver useful longer lead climate forecast information to wool producers.

EVALUATING SEASONAL CLIMATE FORECAST INFORMATION FOR PASTORALISTS

Monthly outputs of probabilities of exceeding long-term median rainfall and simulated pasture growth from the AussieGRASS spatial model form the basis of a project website to evaluate SCFs. A range of forecast periods and lead times throughout the year are considered. Variations in within-season rainfall can result in large variations in growth, and simulations of pasture growth that integrate daily rainfall and other climate and environmental data generally provide a better and more robust assessment of seasonal conditions (e.g. Stafford Smith and McKeon 1998). Hence, probability of exceeding median pasture growth was considered a more useful measure of seasonal outlook than rainfall alone.

The SOI phase (Stone *et al.* 1996) and the 9-phase SST (Drosdowsky 2002) systems that produce three-monthly forecasts have been extended in this evaluation framework (*LWW Map Arranger*) to consider longer lead times and forecast periods than available operationally. Expansion to include other SCF systems is also under development. A simple skill test (Chi square) is calculated spatially in association with each forecast, and statistical methods can be applied to select forecasts that have regional significance. This subset of forecasts can then be assessed within each region relative to the management of pastoral properties. Testing was successful in identifying forecasts with potential to support some management decisions. For example for western NSW Alemseged *et al.* (this conference) illustrate forecast skill with the SOI phase system being useful in winter/spring with lead times of up to three months. In western Queensland the forecast period of most importance for wool producers is summer (November to March) and using the SOI phase system, useful forecasts were identified for this 5-month period with up to one month lead, i.e. using the August-September phase.

A limitation of operational SCF systems is that they do not currently offer sufficient lead time to support those management decisions that have to be made 6 to 12 months ahead. Further, there is as yet no information on the risk of multi-year droughts which have had such an important impact on environmental and economic sustainability of grazing enterprises. In the future new SCF systems now being developed and tested will address some of these issues (e.g. Day *et al.* 2000, White *et al.* 2003). There is also an emerging capability to predict development of El Niño or La Niña conditions using Global Climate Models (GCMs), and a growing understanding of the relationship between SSTs in the Pacific Ocean and rainfall in Australia. This capability has resulted in increasing public discussion of probabilities of an El Niño developing, especially during the 2002 drought. We explored the potential for using forecasts based on El Niño–Southern Oscillation (ENSO) predictions from the International Research Institute for Climate Prediction (IRI) for climate risk management in pastoral enterprises.

COMPOSITE FORECASTS USING ENSO AND INTER-DECADAL PROBABILITIES

Probabilities of ENSO conditions have been interpreted in terms of the probability of exceeding median rainfall or pasture growth in the rangelands of Australia. Years from 1890 were classified as El Niño, neutral or La Niña using SOI values, allowing an overall *composite* probability of rainfall exceeding the long-term median to be calculated based on current year-type. The advantage of this approach is that it provides a longer lead forecast that is consistent with public reports and that can be updated rapidly in response to changing probabilities of an El Niño developing. We are assessing this new approach, including how to handle the small differences in SOI-based classification of years as El Niño, neutral or La Niña compared to the IRI ratios of 25%, 50%, 25%, and possible conservative nature of the forecast.

Studies (e.g. McKeon *et al.* 2004) have shown an interaction between ENSO indices (e.g. SOI) and indices of inter-decadal variability in the Pacific Ocean. Indices of SOI for Jun.–Nov. and the Pacific Decadal Oscillation (PDO) for Dec.–Feb. were used to classify historical years into six year-types: 1. El Niño – *warm* PDO; 2. El Niño – *cool* PDO; 3. Neutral – *warm* PDO; 4. Neutral – *cool* PDO; 5. La Niña – *warm* PDO; and 6. La Niña – *cool* PDO. The Dec.–Feb. PDO was chosen because it showed no significant correlation with SOI for the coming year but allowed the development of a composite forecast for rainfall using the PDO phase available at the end of summer and monthly updates from the IRI of ENSO probabilities for the year ahead. Predictions of simulated pasture growth for each year-type were based on starting conditions (including soil moisture, surface cover, pasture biomass and grass basal area). Interestingly, El Niño – *cool* PDO years were often associated with below average rainfall and pasture growth over large areas of the rangelands. La Niña – *cool* PDO years appear to most often provide good opportunity for recovery. There was some evidence for trends in these year-types over the last hundred years with the former becoming drier and the latter wetter. Preliminary analyses have been made of the relationship between SOI – PDO year-types and historical drought periods but a major challenge is whether extreme droughts or sequences of dry years can be predicted. In summary, the new 'composite' approach to providing climate information based on SOI – PDO year-types indicates a potential for longer lead forecasts that are consistent with publicly available information. Continued evaluation in collaboration with regional projects will indicate whether this approach could facilitate adoption of SCF information by wool producers for improved management of climate variability in the rangelands.

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