What will climate change REALLY mean to graziers in the Western Catchment of NSW

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Abstract
Graziers in the Western Catchment of New South Wales (NSW) experience a climate that varies both seasonally and across the region with several implications for how land, water, pasture and animal production are managed. The Western Catchment Management Authority (WCMA) is a statutory authority managing the natural resources of the Western Catchment, an area of 230,000 square kilometres (29% of NSW) and encompasses multiple land uses including extensive grazing, dryland cropping, irrigated agriculture, mining, tourism and nature conservation. The implications of predicted climate change for graziers are blurred by an overload of information - often clouding the issue of 'does climate change exist and are any changes necessary'. This leads to uncertainty that then impacts on short and long term management decisions. Current literature demonstrates that there is evidence of upward trends to temperature, rainfall and carbon dioxide (CO_2) levels at a global, national and regional level. Regardless of how these changes are named, the evidence illustrates that they are real trends. Graziers can expect changes in plant and animal migrations, erosion, algae blooms, heat stress-related animal production issues and grasses being out-competed by thickening woody cover. To manage uncertain changes, graziers must have the capacity to evaluate, implement and monitor strategic management options – ensuring their ability to adapt and be resilient. This paper identifies predicted needs for change that are within the means and abilities of landholders as well as supporting agencies.

Introduction

Evidence indicates that from as early as the 1820's (Harding 2007) the contribution of green-house gases to global warming and climate change was discussed, debated and argued. Currently, the vast amounts of conflicting information bombarding people on a regular basis has become overwhelming to the point the number of people who accept climate change or global warming has declined by 20% compared to four years ago (Lorimer-Ward 2011 pers. com). This paper will consider the changes of temperature, CO_2 and rainfall – globally, nationally and at a catchment level. It will consider the likely ramifications and identify management considerations for western NSW landholders. This paper does not identify, discuss or debate the influences behind changes, mitigation or programs that are available.

Global and National Evidence of Change to Carbon Dioxide, Temperature and Rainfall Trends

Simply put, the CO_2 levels is a concern as it acts like a blanket around the earth, preventing radiation from escaping and subsequently contributing to an increase in temperature. During the period 1800 to 2007, CO_2 levels increased from 290 ppm (parts per million) to 385 ppm and temperature from a mean global average of 13.5^0 C to 14.5^0 C (Weart 2009). The Carbon Dioxide Information Analysis Centre (CDIA 2012) validates this upward trend with ice core data gathered from the Siple Research Station in West Antarctica going back as far as 1880.

With an accuracy of $^{+}/_{-}$ 2 years, 144m cores have been analysed for temperature and CO_2 information. This information has been combined with data from the Mauna Loa Research Station in Hawaii. Figure 1 illustrates the findings; note the 1^0C increase in temperature over the time period.

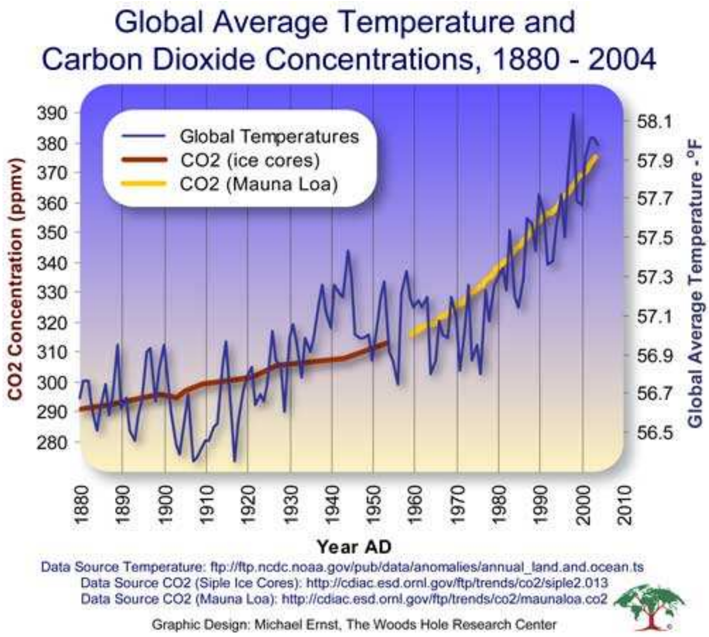

Fig. 1. Global Average Temperature and CO_2 changes 1880 – 2004 (CDIAC 2012)

Due to the global variability of rainfall driven by factors such as the Sub Tropical Ridge, Southern Oscillation Index , El Nino Southern Oscillation and La Nina Southern Oscillation, the Indian Ocean Dipole and Southern Annual Mode, it is difficult to determine a long term global trend, as illustrated in Fig. 2.

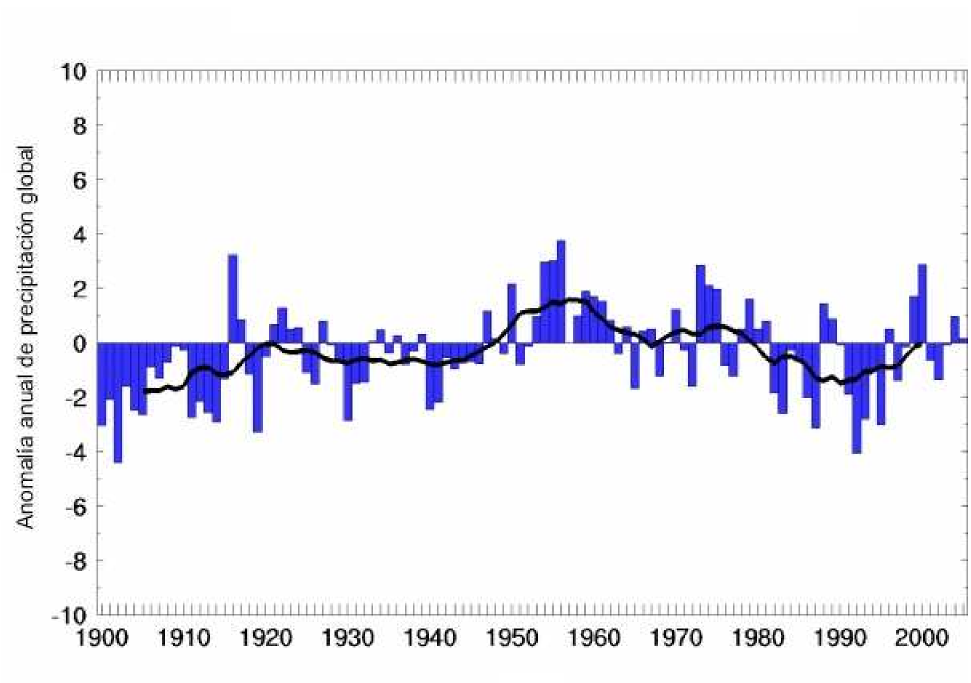

Fig. 2. Global Annual Rainfall. (Australian Bureau of Meteorology 2012)

Australian data is available to determine national and regional rainfall and temperature comparisons with global trends. CO_2 data does not appear to be available for Australia alone. Any data collection (such as at Cape Grimm in Tasmania) is combined with the Antarctica data in Fig. 1, an assumption is made that global CO_2 levels are representative of Australian levels.

Nationally, the recently released report, State of the Climate 2012 (CSIRO-BOM 2012) demonstrates Australia's temperature is behaving similarly to the average global temperature with Fig 3 showing a gradual trend upward since 1910.

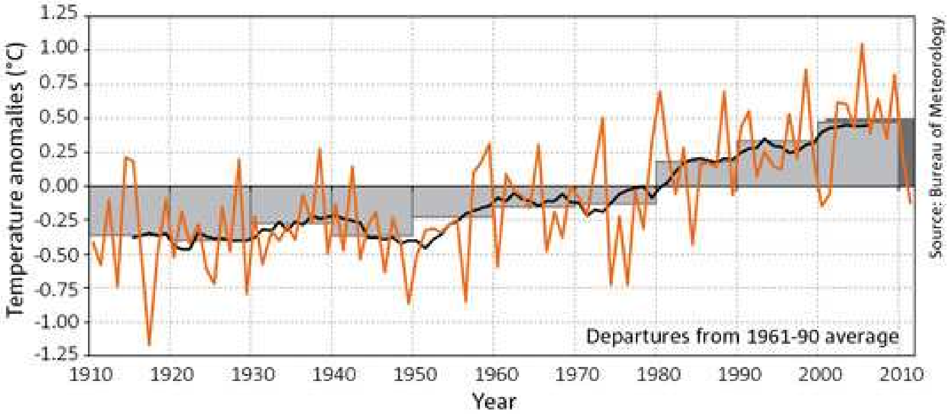

Fig. 3. Changes in average temperature for Australia for each year (orange line) and each decade (grey boxes), and 11-year average (black line – an 11-year period is the standard used by the Intergovernmental Panel on Climate Change). (Australian Bureau of Meteorology 2012)

National rainfall data is also demonstrates an upward trend since 1900 as seen in Fig 4.

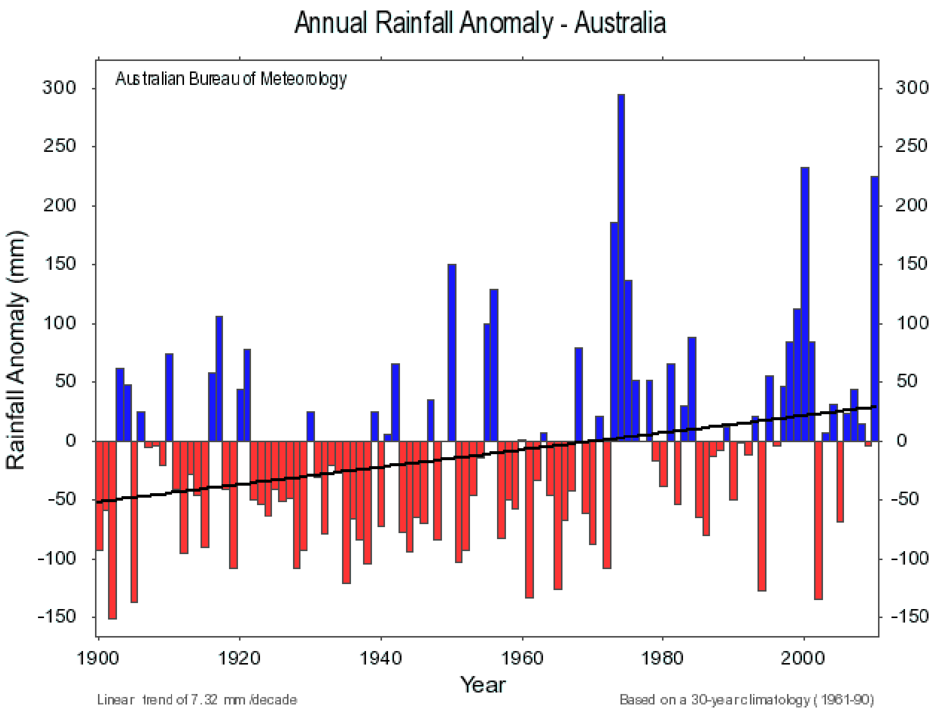

Fig. 4. Anomalies in Australia's rainfall. (Australian Bureau of Meteorology 2012)

Regional Trends

The information presented indicates upward trending changes in temperature and CO_2 levels at a global and national level with national increases in rainfall. This trend in temperature at a regional level in the Western Catchment of NSW is illustrated in Fig. 5. For this region, temperature has increased around 1^0C since 1910.

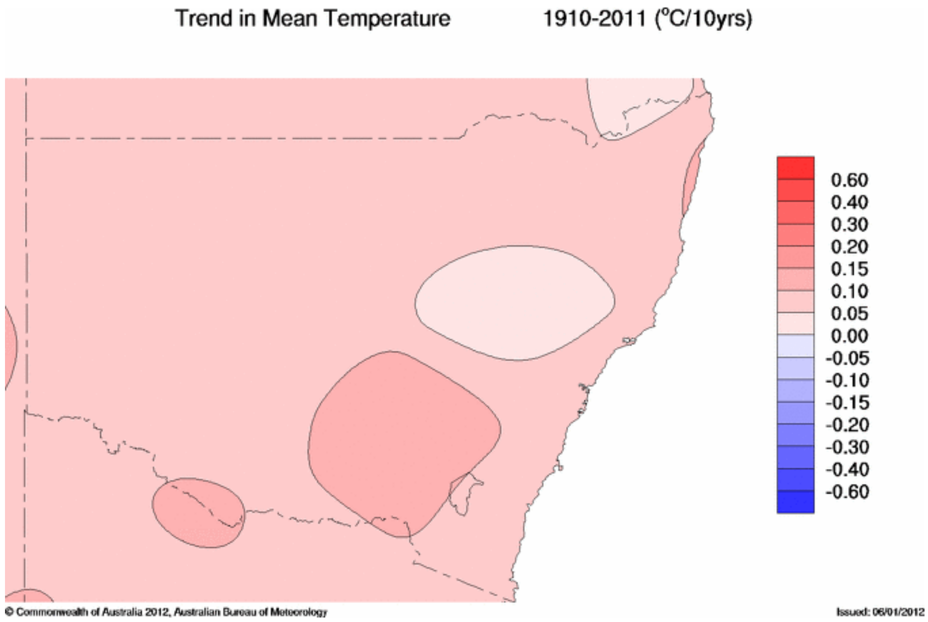

Fig. 5. Increase in annual average daily mean temperature from 1910 to 2011 (in °C). (Australian Bureaus of Meteorology 2012)

Regionally, rainfall trends can also be identified. Figure 6 illustrates an increase in annual rainfall patterns since 1900 even when taking into consideration seasonal variability.

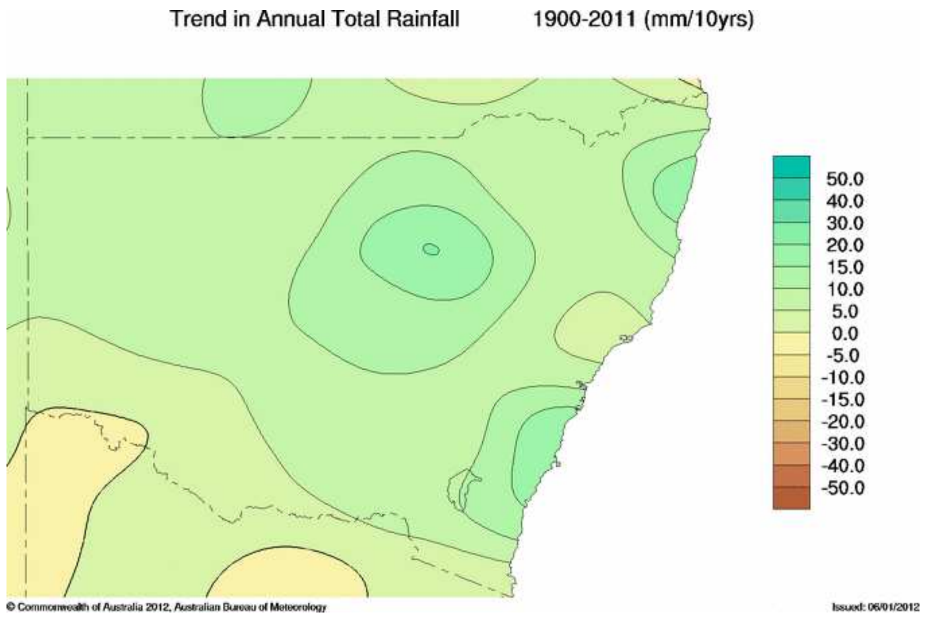

Fig. 6. Shift in average rainfall patterns from 1900 – 2011 (in mm). (Australian Bureaus of Meteorology 2012)

Regional Predictions

Predictions on how temperature and rainfall may continue to change nationally and regionally have been summarised and are available at the Climate Change in Australia site (CSIRO 2102). These projects indicate that by 2050, there will continue to be increases in temperature across the state and regionally. Taking into considerations various levels of CO_2 (emissions), it is expected that spring, autumn and summer will be warmer by between 1 – 2.5^{0}C and winter is expected to increase between 1 and 2^{0}C (Fig.7).

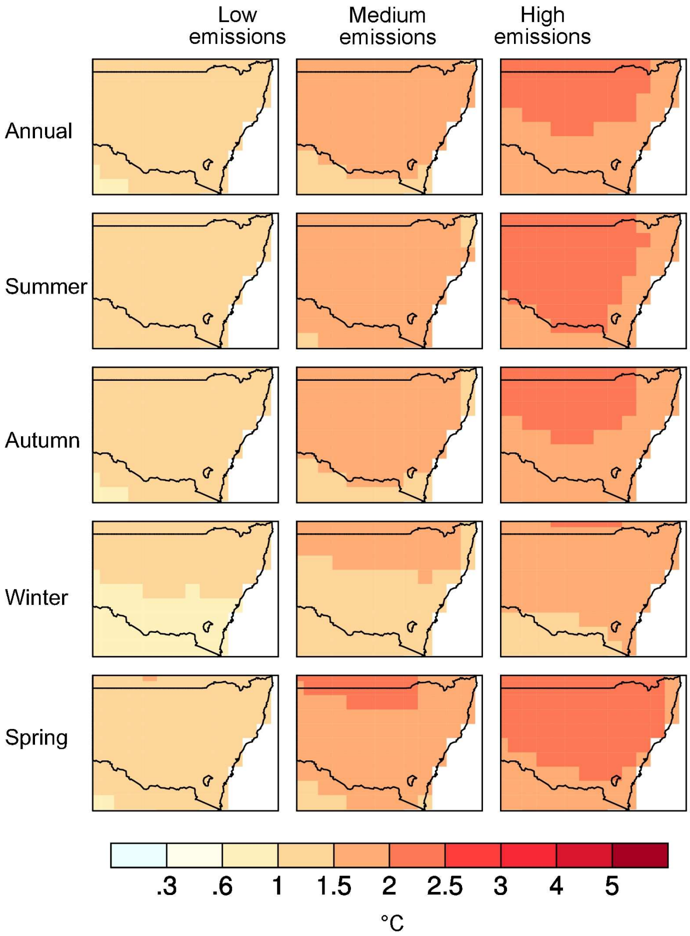

Fig. 7. Projected increases in seasonal average maximum temperatures. (CSIRO 2012)

Rainfall is expected to change in its pattern as well with a trend toward a higher summer component (Fig. 8), a slight decrease in autumn rainfall and greater decreases in winter and spring rainfall.

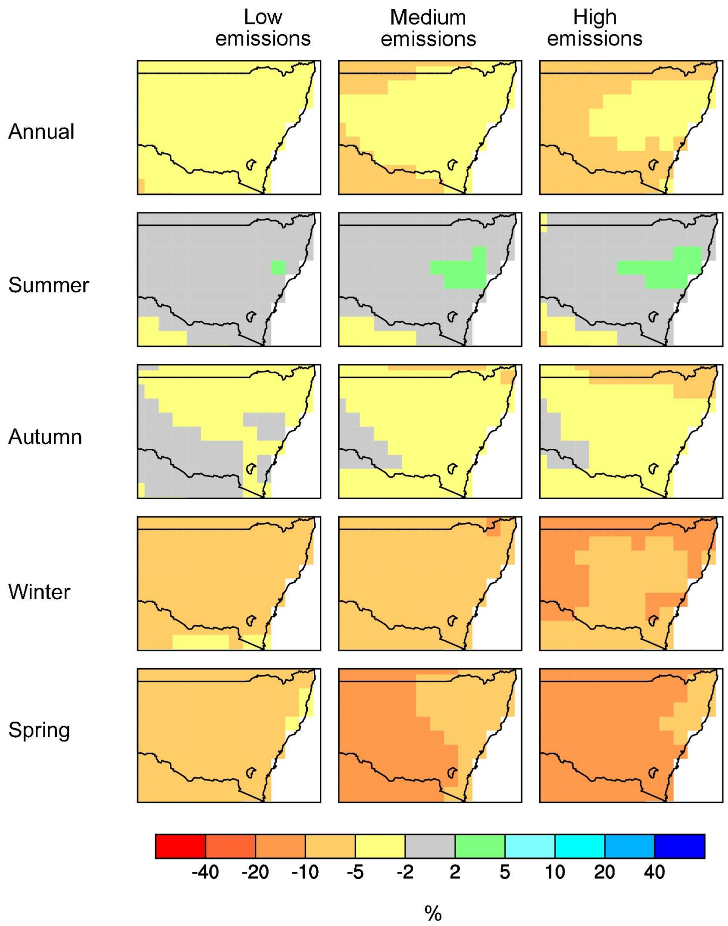

Fig. 8. Projected average seasonal rainfall changes. (CSIRO 2012)

What Does It All Mean and What Can be Done About It

Significant research has been undertaken investigating the potential impacts of changing climate across a variety of Australia's sectors including agriculture and biodiversity. The 2011 Technical Report on Biodiversity (OEH 2011) predicts change in seasonal plant growth as well as plant and animal ranges. This potentially has implications on productivity, water runoff and infiltration, fire regimes and the ability to maintain ground cover or soil carbon levels. Any impact on ground cover will impact productivity, animal management and wind or water erosion.

Indirect and direct changes to biodiversity have already been observed in 'species distributions, life cycle events, abundances, genetic make-up, species interaction and ecosystem-level processes (DECCW 2012). For instance, freshwater invertebrates are declining in some areas as they prefer cooler and fast-flowing waters and sleepy lizards (*Tiliqua spp) are* changing their mating habits to earlier in the season (DECCW 2012). Within the Western Catchment, predictions include an increased abundance of weed species such as noogoora burr (*Xanthium occidentale*) and Bathurst burr (*Xanthium spinosum*). The size, density and range of shrubby plants such as mesquite (*Prosopis spp*), turpentine (*Eremophila sturtii*), hop bush (*Dodonaea spp*) and punty bush (*Eremophila mitchelli*) may increase. This is supported by Stolte (2012) in discussing how woody species in America are adapting to climate change and becoming highly competitive at displacing grasses. Mitigation actions may involve addressing weed outbreaks as a priority in managing vegetation.

Local studies have shown actual rangeland temperatures can be 20^{o}C higher than that forecasted by the Australian Bureau of Meteorology (Curran pers. com.). Resultant heat stress impacts on sheep are largely underestimated with consecutive days of over 32^{0}C showing an impact on fertility, productivity and maintaining a pregnancy to term – with more than five days having major impacts. Mitigation involves activities that protect the animals and minimise their heat exposure, such as increasing shade and ground cover, breeding selection favouring lower body temperature characteristics and ensuring management activities such as lambing, joining and shearing avoid high temperature seasons.

The combination of changes will impact on both seasonal plant growth as well as animal husbandry requirements such as fly strike and fleece rot in sheep with warmer and wetter summers. Management will require an in-depth knowledge of plant and animal species growth patterns and needs – and benefit from tools that support adaptive strategies.

The challenge for rangeland managers is identifying how they might be impacted upon and the short term management strategies to consider for implementation. The current review of the Catchment Action Plan (CAP), presents a timely opportunity for the WCMA to identify how to support these decision making processes and outcomes.

Conclusion

This paper has considered global, national and regional temperature, rainfall and CO_2 trends. An upward trend has been demonstrated and current knowledge indicates with these current and projected trends, graziers can expect changes in their landscapes and to their management practices.

How likely changes in temperature, rainfall and CO_2 are mitigated will depend on enterprises and understanding. At the very least landholders should evaluate, implement and monitor, strategic management options, ensuring the ability to adapt and be resilient. Responses may include increasing ground cover, providing shade, minimising bare earth, managing pest animal and plants, breeding for temperature tolerance and maximum food conversion as well as changing animal husbandry practices to improve productivity – short, managing existing stressors. These are within the means and abilities of landholders and supporting agencies.

Current studies may be inadequate as they relate to only a short time frame of the climate cycle. If landholders undertake management changes and the system evens out with no dramatic changes, they risk better production and management. If the system does change as predicted and changes have not been made, landholders risk their viability!

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