Comparison of recent, short-term rainfall observations with long-term distributions for three centres in northern New South Wales

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Abstract: *Analyses of short- and long-term monthly and annual rainfall data for Warialda, Barraba, and Tamworth on the North-West Slopes of NSW indicated that from 2000–09 there were substantially drier periods in May and wetter periods in November–December compared with the long-term mean. These dry periods were similar to the 1900–49 pattern while the wetter periods were more representative of the 1950–99 climate.*

Introduction

In the popular press, it is often claimed that the conditions experienced since 2000 are unlike those previously experienced and linkages are also frequently made between current climate variability and the likely onset of projected climate change. However, for the North-West Slopes of New South Wales (NSW) projected climate change variations are small compared with the historical variation and those experienced in the last few years (Lodge *et al.* 2009). For example, analyses of climate change projections for a site near Barraba (Cullen *et al.* 2009; Lodge *et al.* 2009), based on the Intergovernmental Panel on Climate Change (IPCC) emission scenarios, indicated that by 2030 annual temperatures were likely to be 1.2 °C higher and rainfall to increase by only 0.3%, but by 2070 temperatures were projected to be 2.7 °C higher for a mid-emissions scenario and 4.4 °C higher for a high scenario, but annual rainfall increases were only 0.7 and 1.2% higher, respectively (based on output from the CSIRO Mark 3 global circulation model). These increases in rainfall are relatively modest compared with those that historically occurred in periods of wet and dry years in the 1900s (Lodge *et al.* 2009). Large variations in inter-annual rainfall and differences of about 15% in mean annual rainfall in the first (drier) and second (wetter) halves of the 1990s were reported by Lodge & Brennan (2008) and Lodge *et al.* (2009). This variation was also recorded by Lodge *et al.* (2003) for a Sustainable Grazing Systems (SGS) National Experiment site, located 20 km south-east of Barraba on the North-West Slopes of NSW.

In this paper, we use observed rainfall recorded at Bureau of Meteorology weather stations located on a north-south transect at Warialda, Barraba, and Tamworth on the North-West Slopes of NSW to examine and document long-term (1900–2009) variation in annual and monthly rainfall, compared with the last decade (2000–09) and to highlight any abnormal features. These values were also compared with those for the last century and climate change projections for the Barraba site in 2030 and 2070 (Cullen *et al.* 2009).

Methods

Monthly rainfall data (mm) for the locations of Tamworth (a composite of Tamworth Airport 1876–1992, Station number 55054 and Tamworth Airport AWS, 55325, 1993–2009), Barraba (Barraba Post Office (PO), 54003, 1882–2009) and Warialda PO (54029, 1879–2009) were downloaded from the Bureau of Meteorology website (Bureau of Meteorology 2010*a*). For each location, monthly values were summed each year to give annual totals for the periods 1900–2009 (110-year long-term), 1900–49 (the first-half of last century), 1950–99 (the second-half of last century) and 2000–09 (10-year short-term). Annual rainfall data were plotted to show their inter-annual variation and the mean values for these different periods, together with the mean value for the 30-year period 1961–90, which is the reference climate normal period (Bureau of Meteorology 2010*b*) and often used as a baseline to compare climate change. For the periods 1900–2009, 1900–49, 1950–99 and 2000–09, monthly data were also examined graphically and their means and standard errors calculated. For the Barraba PO data, climate change projections were simulated for a 2030 medium-emissions scenario and 2070 medium- and high-emissions scenarios, using the baseline data for 1971–2000 (Cullen *et al.* 2009).

Results and discussion

In the past 10 years, the most outstanding features of the climate patterns at all three locations were the substantially drier periods in May and wetter periods in November–December (Fig. 1) compared with the long-term mean. There was also a tendency for below average rainfall in late winter in the past 10 years (Fig. 1), but the deviations from the long-term average were within the expected range. Below average rainfall in May is not in itself an unusual feature, occurring at a frequency of about 1 year in 3. At all locations, what was abnormal for the past decade or so was that the dry periods in May occurred in 12 consecutive years at Tamworth, 11 consecutive years at Barraba and 8 consecutive years (and 9 of the past 10 years) at Warialda. Previous periods with consecutively dry Mays were: Tamworth (4–7 years) in 1906–12, 1914–18, 1922–25, 1927–30, 1932–37, 1970–76; Barraba (4–5 years) in 1906–10, 1914–18, 1927–30, 1932–35, 1939–43 and 1970–73, and Warialda (5–7 years) in 1905–10, 1926–30, 1939–43 and 1970–76. Interestingly, compared with the wetter period of 1950–99, below-average rainfall in May occurred at about a 20% higher frequency (65 *v.* 45%) in 1900–49 and most of the substantive consecutively dry May periods occurred in the first half of last century, when mean annual rainfall was lower (Fig. 2). At all locations there was no association between May rainfall and total annual rainfall, but there was a significant and positive relationship between summer and total annual rainfall, as previously reported by

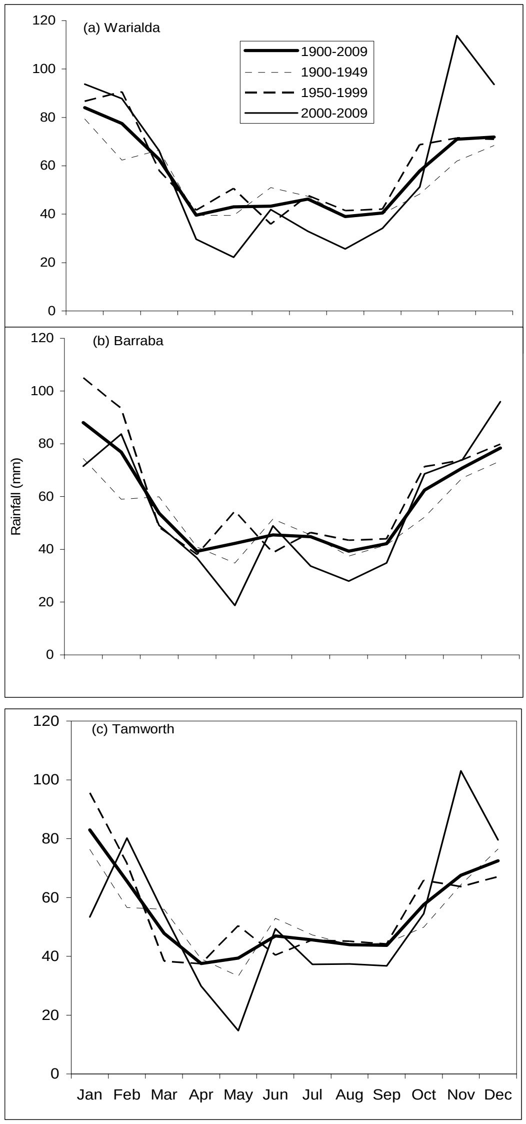

Figure 1. Mean monthly rainfall (mm) at (*a*) Warialda, (*b*) Barraba and (*c*) Tamworth for the periods 1900–2009, 1900–1949, 1950–1999 and 2000–2009.

Lodge (2005) for a broader network of sites in northern NSW.

Compared with the long-term, the average rainfall in November (Tamworth), December (Barraba) and both of these months (Warialda) was markedly higher in the past 10 years. Similar to the May pattern, this feature was associated with a high number of consecutive years with November or December rainfall that was above average. However, overall there were

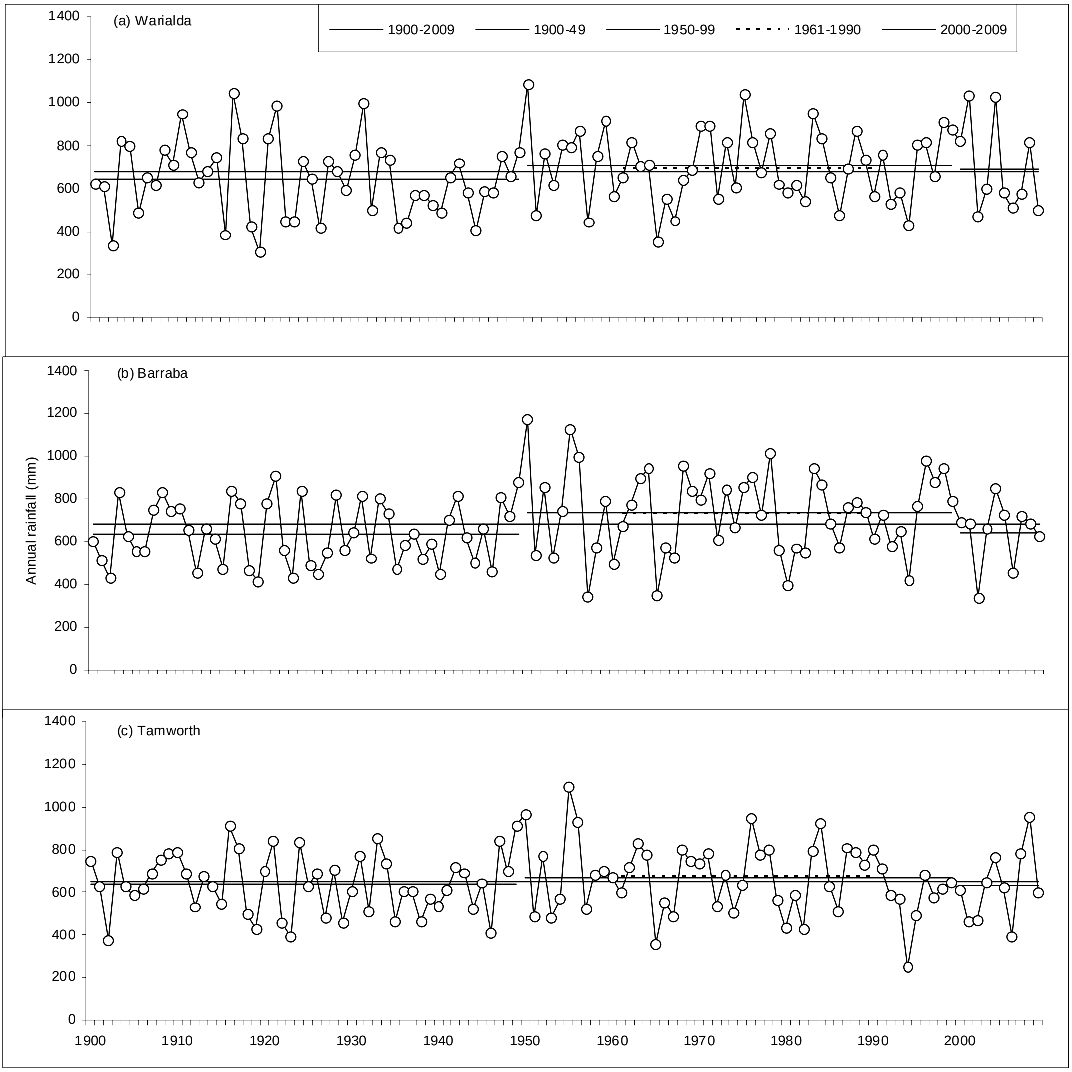

Figure 2. Annual rainfall (mm) recorded at (*a*) Warialda, (*b*) Barraba and (*c*) Tamworth from 1900–2009 together with the mean annual rainfall (horizontal lines) for 1900–2009, 1900–49, 1950–99, 2000–09 and 1961–90 (the reference climate normal period, dashed line).

fewer previous years with consecutively higher rainfall in these months and all were in the wetter period 1950–99.

The recent (2000–09) climate pattern was therefore abnormal in that it contained two main features: (1) consecutive years with below average rainfall in May, which were more a feature of the 1900–49 pattern, and (2) wetter than average periods in November and/or December, which were more representative of the 1950–99 climate. Rainfall analyses for Pilliga, Gunnedah, Moree, Bendemeer and Bundarra have shown a very similar pattern. These abnormal weather patterns have profound implications for livestock production, since adequate May rainfall is required for the germination and growth of annual, winter-growing legumes and late sown cereal forage crops and November–December is a critical period for sowing and establishing tropical perennial grass pastures and the growth of summer-growing native perennial grasses.

At Barraba, total annual rainfall for the wetter period 1950–99 was similar to that for all of

Table 1. Mean monthly and annual rainfall (mm ± standard error) at Barraba from 1900–2009, 1900–49, 1950–99 and 2000–09 together with the projected values for climate change scenarios for 2030 medium-emissions, 2070 medium-emissions and 2070 high-emissions, using the 30-year period 1971–2000 as the baseline climate data.

Period	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1900-2009	88±6.3	77±6.3	54±4.5	39±3.3	42±3.5	45±3.4	45±3.5	39±2.9	42±3.1	62±3.8	71±4.7	78±4.8	683±16.7
1900-1949	74±8.1	59±6.5	60±7.8	41±4.2	35±4.3	51±5.6	45±5.0	37±4.1	42±4.8	52±4.8	67±6.4	73±6.9	638±20.3
1950-1999	105±10.2	93±11.6	48±5.6	38±5.3	54±6.0	38±4.3	46±5.6	44±4.7	44±4.7	71±6.5	74±7.8	80±7.1	737±27.6
2000-2009	72±21.2	84±9.7	49±11.4	37±13.0	19±4.3	49±11.9	34±6.7	28±6.5	35±8.7	69±9.6	74±14.0	96±18.9	644±46.2
2030 medium	122±13.3	92±12.9	50±7.9	39±8.1	56±7.9	38±5.0	49±7.1	35±5.1	45±6.3	57±6.2	76±9.0	77±8.4	745±30.1
2070 medium	137±14.9	101±14.0	55±8.7	39±8.0	54±7.6	36±4.7	46±6.6	33±4.7	45±6.3	48±5.3	70±8.3	76±8.4	758±30.6
2070 high	154±16.7	110±15.3	60±9.6	39±7.9	51±7.2	34±4.4	43±6.1	30±4.3	45±6.3	38±4.2	64±7.5	76±8.3	773±31.2

the climate change scenarios, and rainfall totals for the drier 1900–49 period were similar to those for 2000–09 (Table 1). Below average rainfall in May and above average rainfall in November–December was not indicated in any of the simulated climate change projections for Barraba (Table 1) generated by the analysis of Cullen *et al.* (2009). At Barraba, the trend in the climate change projection data was for total annual rainfall to increase by up to 12% compared with the long-term mean and for rainfall in January–February to be higher, while that in October–November was lower than the long-term average (Table 1). However, these simulated projections did not take into account the likelihood of an increased frequency of extreme events that may occur with climate change. The possibility that the deviations from the long-term means for May and November–December rainfall from 2000–09 may be an expression of this increased frequency of extreme events, occurring at times traditionally associated with 'the change of season,' needs to be considered. Locally, further monitoring is required to see if these short-term trends continue and wider testing in different regions and climatic zones is warranted to determine if similar patterns can be detected.

References

Bureau of Meteorology, (2010*a*) Weather Station data. http://www.bom.gov.au/climate/data/weather-data.shtml

Bureau of Meteorology, (2010*b*) About Climate Statistics. http://www.bom.gov.au/climate/cdo/about/about-stats.shtml

Cullen, BR, Johnson, IR, Eckard, RJ, Lodge, GM, Walker, RG, Rawnsley, RP & McCaskill, MR (2009) Climate change effects on pasture systems in south-eastern Australia . *Crop & Pasture Science* 60, 933–942.

Lodge, GM, Murphy, SR & Harden, S (2003) Effects of grazing and management on herbage mass, persistence, animal production and soil water content of native pastures. 1. A redgrass-wallaby grass pasture, Barraba, North-West Slopes, New South Wales. *Australian Journal of Experimental Agriculture* 43, 875–890.

Lodge, GM (2005) Using long term seasonal rainfall records to predict the likelihood of above or below average total annual rainfall in a summer rainfall environment. In 'Proceedings of the 20th Annual Conference of The Grassland Society of NSW'. (Ed HL Davies) pp. 116–119. (NSW Grassland Society Inc.: Orange).

Lodge, GM & Brennan, MA (2008) Rainfall and soil water content at a native pasture site near Barraba, NSW; 2003–2008. In 'Proceedings of the 23rd Annual Conference of The Grassland Society of NSW'. (Eds SP Boschma, LM Serafin and JF Ayres) pp. 137–140. (NSW Grassland Society Inc.: Orange).

Lodge, GM, Johnson, IR & Cullen, BR (2009) Effects of climate scenarios on simulated intake of sheep grazing native pastures in northern New South Wales, Australia. *Animal Production Science* 49, 1015–1022.