Appendix 9: Timing of autumn breaks and lengths of springs in Tasmanian beef and sheep regions under future climate scenarios

Submitted for publication in the 53rd Annual Grasslands Society of Southern Australia (GSSA) Conference Proceedings; July 2012, Launceston, TAS, Australia.

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Introduction

Climate is an important driver of pasture production and the intra-annual variability in climate results in different patterns of pasture production which needs to be managed to meet feed demands on beef and sheep farms. In recent decades, south eastern Australia has experienced a decline in total annual rainfall (Australian Bureau of Meteorology 2008), with the most substantial reduction occurring in autumn (Gallant *et al.* 2007). General Circulation Models (GCMs) provide the best estimates for assessing potential changes to the climate on a global scale however projections of climate change are not evenly distributed over the globe. This necessitates that local or regional climate projections are required to quantify local or regional climate impacts (Corney *et al* 2010). The Climate Futures for Tasmania (CFT) project generated climate projections specific to Tasmania through a dynamical downscaling approach (Grose *et al.* 2010). This downscaling approach increased the spatial resolution from 2° to 3° grid cells (~200 to 300km) in the GCMs down to a 0.1° grid (~10km) for Tasmania, thus capturing regional and sub-regional differences allowing the projected climate change impacts to be quantified on a local scale (Corney *et al* 2010).

The timing of the autumn break is most strongly influenced by precipitation, and its occurrence strongly influences feed availability for autumn calving/lambing or the accumulation of a feed wedge for late winter/ early spring calving/lambing. The ability to meet increased nutritional demands associated with an autumn joining is also strongly influenced by feed availably during the autumn period. The duration of springs may be short or long, depending on soil moisture availability and the onset of warmer temperatures. The length of the spring season influences both the quality and quantity of available feed, livestock production potential, and the demand for either conservation or purchase feeds. This study examined the changes in frequency of late and early autumn breaks and frequency of long and short spring seasons for two extensive agricultural regions of Tasmania out to the year 2090 using climate projection data from the CFT project.

Methods

Daily climate data developed from the CFT project (https://dl.tpac.org.au/) was accessed for Cressy (41.7°S, 147.1°E) and Ouse (42.5°S, 146.7°E). For both regions, six down-scaled A2 emissions scenario GCM files (CSIRO-Mk3.5, UKHad, ECHAM5, GFDL 2.0, GFDL 2.1 and MIROC3.2) were used, in combination with the Sustainable Grazing Systems (SGS) biophysical simulation tool (Johnson *et al.* 2003), to simulate a monthly cut study for a rain-fed perennial ryegrass pasture sward using a generic clay loam soil. Monthly pasture growth rates (PGR; kg dry matter/ha.day) were simulated using climate data from a baseline period (years 1971 to 2000) and three future climate periods (years 2001 to 2030, 2031 to 2060 and 2061 to 2090). The frequency of late and early autumn breaks and frequency of long and short spring seasons were defined in terms of monthly PGRs following a similar method as described by Chapman *et al.* (2008):

- Early autumn break: PGR in both March and April > baseline period average for March and April
- Late autumn break: PGR in both April and May < baseline period average for April and May

- Short spring season: PRG in both October and November < baseline period average for October and November
- Long spring season: PRG in both November and December > baseline period average for November and December

Results

There was generally good agreement (less than 10kg DM/ha.day difference except in November at Cressy and in November and December at Ouse) between the six GCMs for simulating mean monthly PRGs for the baseline period (data not shown). The mean daily temperature, as a average of the six GCMs, was predicted to increase by 0.5, 1.3 and 2.3°C at Cressy and by 0.5, 1.2 and 2.2°C at Ouse in the period of years 2001 to 2030, 2031 to 2060 and 2061 to 2090, respectively, when compared to the baseline period of years. Annual rainfall changes, relative to the baseline rainfall, for Cressy and Ouse were +3.6, +4.3 and +7.7% and +0.5, +2.6 and +4.5% in the period of years 2001 to 2030, 2031 to 2060 and 2061 to 2090 periods, respectively.

Autumn breaks

The frequency of early autumn breaks, as a mean of the six GCMs, was predicted to increase from 18% (i.e. 5.5 years out of 30) in the baseline period of years to 28% by years 2061 to 2090 (Figure 1a) at Cressy. The frequency of early autumn breaks, as a mean of the six GCM, was predicted to increase from 19% (i.e. 5.7 years out of 30) in the baseline period of years to 29% by years 2061 to 2090 (Figure 1b) at Ouse.

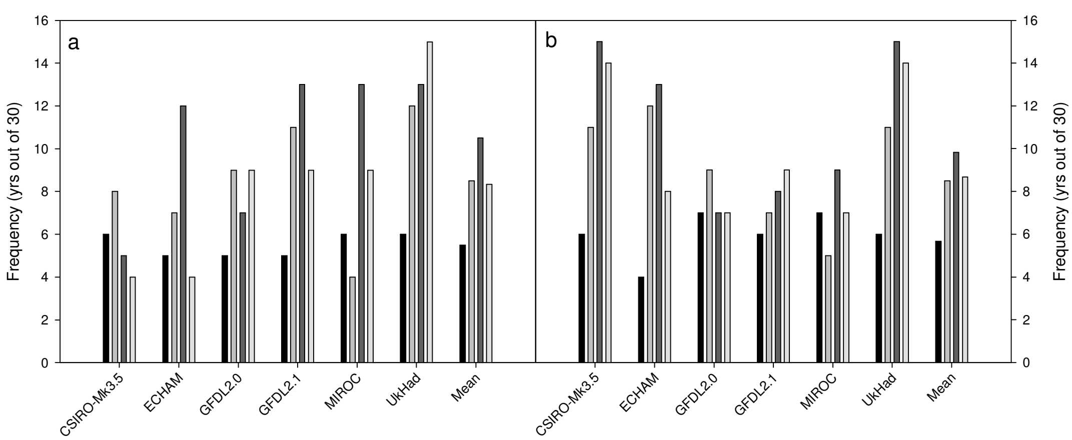

Figure 1. Frequency (number of years out of 30) of early autumn breaks at Cressy (a) and Ouse (b) for six general circulation models for the periods of years 1971 to 2000 (■), 2001 to 2030 (□), 2031 to 2060 (■) and 2061 to 2090 (□).

The frequency of late autumn breaks, as a mean of the six GCMs, was predicted to decline from 39% (i.e. 11.7 years out of 30) in the baseline period of years to 26% by years 2061 to 2090 (Figure 2a) at Cressy. The frequency of late autumn breaks, as a mean of the six GCMs, was predicted to decline from 39% (i.e. 11.8 years out of 30) in the baseline period of years to 23% by years 2061 to 2090 (Figure 2b) at Ouse.

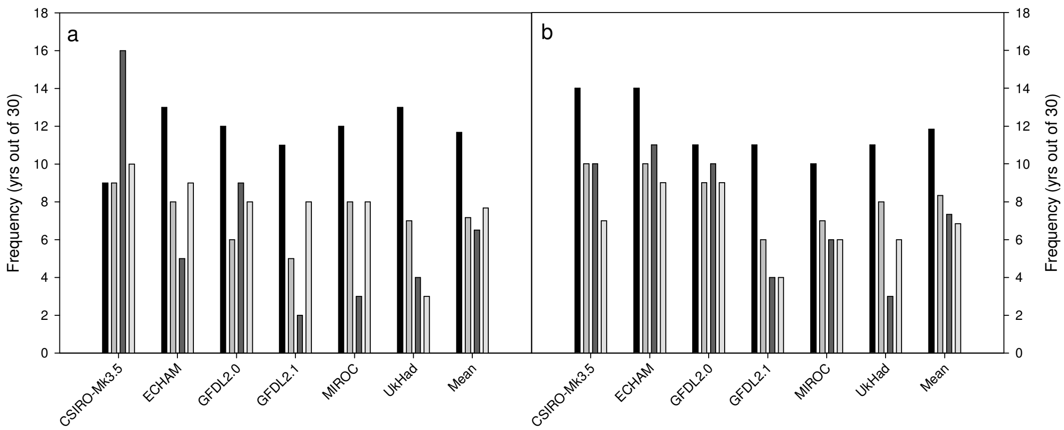

Figure 2. Frequency (number of years out of 30) of late autumn breaks at Cressy (a) and Ouse (b) for six general circulation models for the periods of years 1971 to 2000 (■), 2001 to 2030 (▒), 2031 to 2060 (▓) and 2061 to 2090 (□).

Spring seasons

The frequency of short springs, as a mean of the GCMs, was predicted to decline from 29% (i.e. 8.7 years out of 30) in the baseline period of years to 19% by years 2061 to 2090 (Figure 3a) at Cressy. The frequency of short springs, as a mean of the six GCMs, was predicted to decline from 22% (i.e. 6.5 years out of 30) during the baseline period of years to 13% by years 2061 to 2090 (Figure 3b) at Ouse.

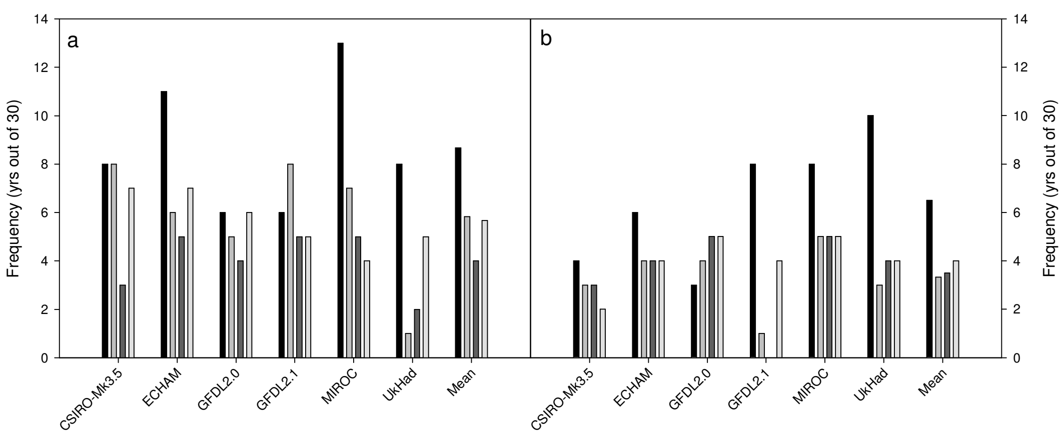

Figure 3. Frequency (number of years out of 30) of short springs at Cressy (a) and Ouse (b) for six general circulation models for the periods of years 1971 to 2000 (■), 2001 to 2030 (▒), 2031 to 2060 (▓) and 2061 to 2090 (□).

The frequency of long springs, as a mean of the six GCMs, was predicted to decline from 22% (i.e. 6.7 years out of 30) during the baseline period of years to 20% during years 2061 to 2090 (Figure 4a) at Cressy. The frequency of long springs, as a mean of the six GCMs, was predicted to decline from 27% (i.e. 8.0 years out of 30) during the baseline period of years to 18% during years 2061 to 2090 (Figure 4b) at Ouse.

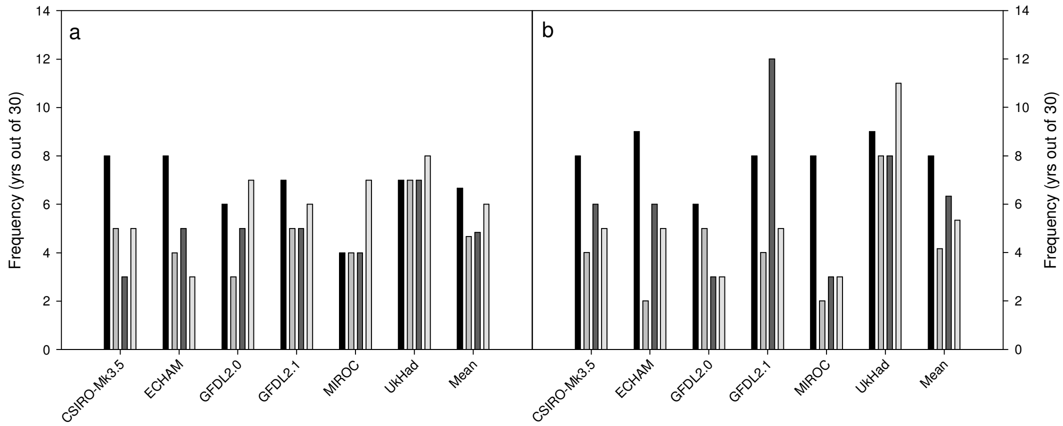

Figure 4. Frequency (number of years out of 30) of long springs at Cressy (a) and Ouse (b) for six general circulation models for the periods of years 1971 to 2000 (■), 2001 to 2030 (□), 2031 to 2060 (■) and 2061 to 2090 (□).

Discussion and conclusions

This study has indicated that the likelihood of the mean frequency of early autumn breaks increased and the mean frequency of late autumn breaks declined, as defined within this study, into the future for both Cressy and Ouse. Increases in PGR above the historical average PGR for the autumn months and reduced autumn variability (early autumn's increase, late autumn's declined) could lead to increased winter feed supply, winter carrying capacity and management confidence. This may increase the capacity for autumn lambing/calving, winter finishing, or leverage increased winter stocking rates and consequent spring pasture harvests in spring calving/lambing enterprises.

This study also concluded that while the frequency of short springs, as defined in this study, was predicted to decline into the future, the frequency of long springs was also predicted to decline into the future. The decline in frequency of short springs was mostly likely a result of warmer temperatures, higher levels of atmospheric carbon dioxide concentrations and minimal changes in precipitation, leading to more consistent PGR for the spring period. However, the decline in the frequency of long spring periods could be as consequence of reduced soil moisture content in late spring/early summer restricting pasture growth. This decline in long springs in these two regions could be offset with deeper rooted pasture species with longer season growth potential, the introduction of irrigation to maximise productivity on beef and sheep enterprises, and the use of management like early weaning strategies or changes in sale target weights to adapt feed demand to changing feed supply. Increased consistency of spring may also assist planning by improving management confidence.

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This study was supported by funding from Dairy Australia, Meat and Livestock Australia, Tasmanian Institute of Agriculture and the Australian Government Department of Agriculture, Fisheries and Forestry under its Australia's Farming Future Climate Change Research Program.