Appendix 7: Timing of autumn breaks and lengths of springs in Tasmanian dairy regions under future climate scenarios

Submitted for publication in the 16th ASA Conference Proceedings; October 2012, Armidale, NSW, Australia

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Abstract

The timing of autumn breaks and the length of the spring growing season are considered two times of the year when pasture growth can be most variable. Daily climate data for two dairy regions of Tasmania (Flowerdale and Ringarooma) was accessed from the 'Climate Futures for Tasmania' project and used to simulate a perennial ryegrass sward using the biophysical pasture model DairyMod. The mean frequency of early and late autumn breaks and frequency of short and long spring seasons for a baseline period (years 1971 to 2000) and three climate periods (years 2001 to 2030, 2031 to 2060 and 2061 to 2090) was predicted for each region using climate projections from six general circulation models. Comparing the mean change between the baseline period and the future climate period, years 2061 to 2090, the frequency of early autumn breaks was predicted to increase from 27% to 33% for Flowerdale and from 26% to 34% for Ringarooma. The frequency of late autumn breaks was predicted to decline from 31% to 16% for Flowerdale and from 34% to 17% for Ringarooma. The frequency of short springs was predicted to decline from 14% and 16% for Flowerdale and Ringarooma, respectively, to < 1% for both regions. The frequency of long springs was predicted to remain relatively stable at ~ 32% for both regions. The results of this study indicate that for both regions of Tasmanian, earlier autumn breaks and a reduction in the frequency of short springs will result in a more reliable growing season. This paper discusses the implications of these results and possible adaptation options.

Key Words

Climate Futures for Tasmania, Flowerdale, Ringarooma, autumn breaks, spring seasons

Introduction

Climate is an important driver of pasture production and the intra-annual variability in climate results in differing patterns of pasture production which needs to be managed to meet feed demands on dairy farms. In recent decades, south eastern Australia has experienced a decline in total annual rainfall (Australian Bureau of Meteorology 2008), with the largest decline occurring in autumn (Gallant *et al.* 2007). General Circulation Models (GCMs) provide the best means of estimating the potential changes to the climate on a global scale. However, projections of climate change are not evenly distributed over the globe. To assess the impact of changes in climate within Tasmania, 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, 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 herds or the accumulation of a feed wedge for late winter/ early spring calving herds. The timing and 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 surplus pasture, which in turn influences the need to purchase feed. This study examined the changes in frequency of late and early autumn breaks and frequency of long and short spring seasons for two dairy regions of Tasmania out to 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 Flowerdale (41.0°S, 145.6°E) and Ringarooma (41.3°S, 147.7°E). For both regions, six down-scaled A2 emissions scenario GCM files (CSIRO-Mk3.5, ECHAM5, GFDL 2.0, GFDL 2.1 and MIROC3.2 and UKHad) were used, in combination with the biophysical model DairyMod (Johnson *et al.* 2008), to simulate a monthly cut study to a residual of 1.4 t DM/ha for a rain-fed perennial ryegrass pasture sward using a generic clay loam soil. Monthly pasture growth rates (PGR; kg DM/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) between the six GCMs for simulating mean monthly PRGs for the baseline period (Figure 1). Across the six GCMs the mean daily temperature increase, relative to the baseline temperature, for Flowerdale and Ringarooma were 0.5, 1.2 and 2.2°C and 0.5, 1.3 and 2.3°C in the 2001-2030, 2031-2060 and 2061-2090 periods, respectively. Annual rainfall changes, relative to the baseline rainfall, for Flowerdale and Ringarooma were -2.3, -1.8 and -0.2% and -0.5, +1.6 and +4.8% in the years 2001 to 2030, 2031 to 2060 and 2061 to 2090 periods, respectively.

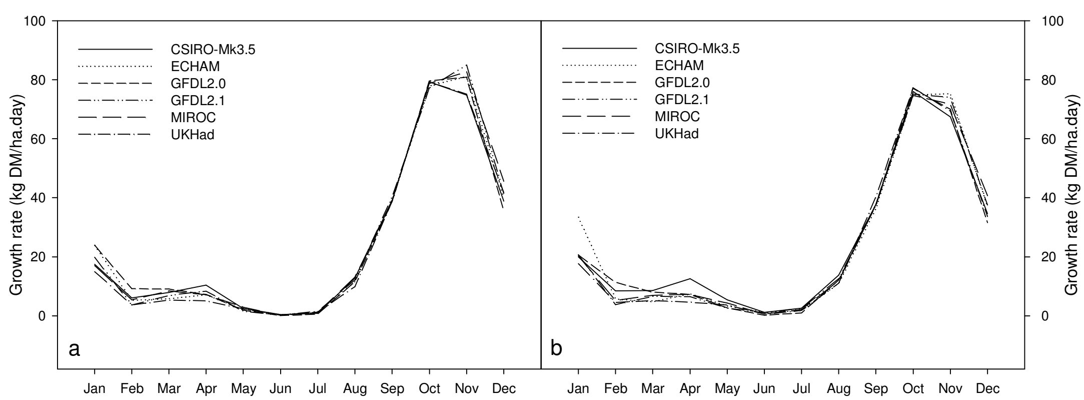

Figure 1. Mean monthly pasture growth rate (kg DM/ha.day) for Flowerdale (a) and Ringarooma (b) for the baseline (years 1971 to 2000) climatic period according to six general circulation models.

Autumn breaks

For Flowerdale and Ringarooma, the frequency of early autumn breaks (Figure 2), as a mean of the six GCMs, was lower than the frequency of late autumn breaks (Figure 3), as a mean of the six GCMs, during the baseline period of years. At Flowerdale, the frequency of early autumn breaks, as a mean of the six GCMs, was predicted to increase from 27% (i.e. 8.0 years out of 30) in the baseline period to 33% by years 2061 to 2090 (Figure 2a). At Ringarooma, the frequency of early autumn breaks, as a mean of the six GCMs, was predicted to increase from 26% (i.e. 7.7 years out of 30) in the baseline period to 34% by years 2061 to 2090 (Figure 2b).

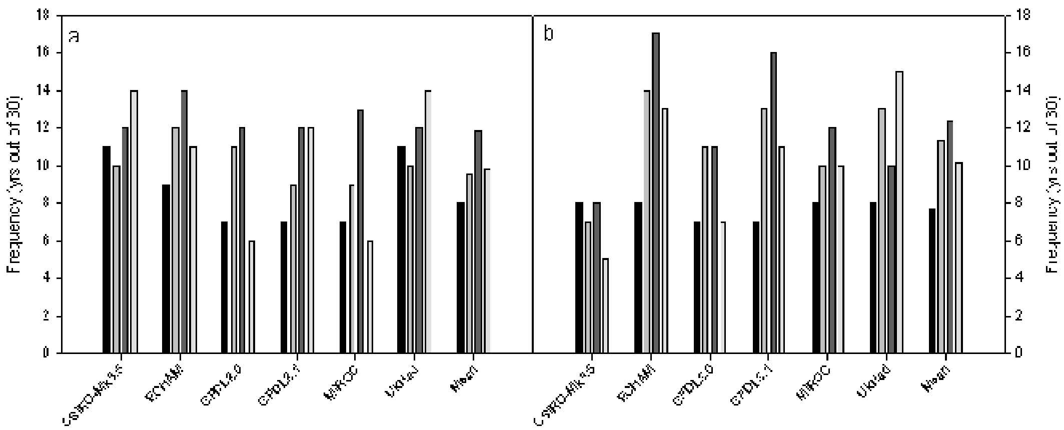

Figure 2. Frequency (number of years out of 30) of early autumn breaks at Flowerdale (a) and Ringarooma (b) for six general circulation models for the periods of years 1971 to 2000 (■), 2001 to 2030 (□), 2031 to 2060 (■) and 2061 to 2090 (□).

At Flowerdale, the frequency of late autumn breaks, as a mean of the six GCMs, was predicted to decline from 31% (i.e. 9.3 years out of 30) in the baseline period to 16% by years 2061 to 2090 (Figure 3a). At Ringarooma, the frequency of late autumn breaks, as a mean of the six GCMs, was predicted to decline from 34% (i.e. 10.2 years out of 30) in the baseline period to 17% by years 2061 to 2090 (Figure 3b).

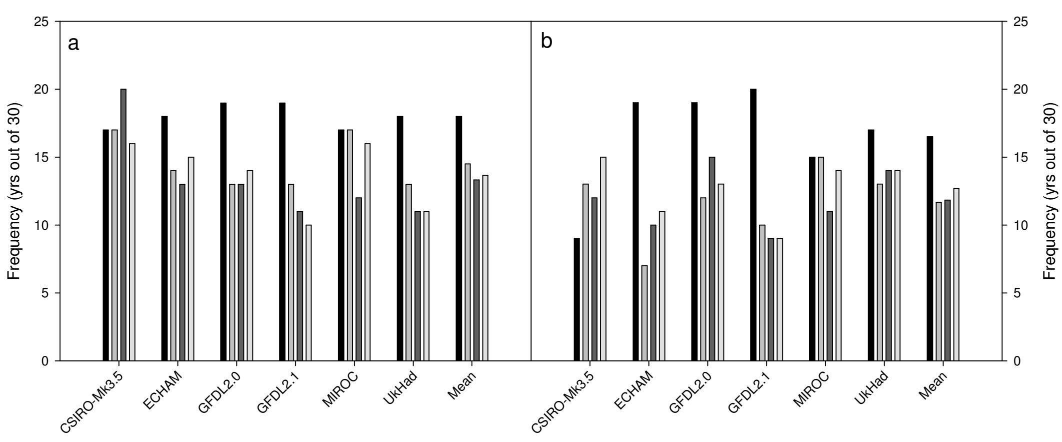

Figure 3. Frequency (number of years out of 30) of late autumn breaks at Flowerdale (a) and Ringarooma (b) for six general circulation models for the periods of years 1971 to 2000 (■), 2001 to 2030 (□), 2031 to 2060 (■) and 2061 to 2090 (□).

Spring seasons

For Flowerdale and Ringarooma, the frequency of short springs (Figure 4), as a mean of the six GCMs, was lower than the frequency of long springs (Figure 5), as a mean of the six GCMs, during the baseline period of years. At Flowerdale, the frequency of short springs, as a mean of the six GCMs, was predicted to decline from 14% (i.e. 4.2 years out of 30) in the baseline period to < 1% by years 2061 to 2090 (Figure 4a). At Ringarooma, the frequency of short springs, as a mean of the six GCM's, was predicted to decline from 16% (i.e. 4.8 years out of 30) in the baseline period to < 1% by years 2061 to 2090 (Figure 4b). There was general consensus between GCM's that the frequency of short springs would decline dramatically in all three future climate periods when compared to their corresponding baseline period (with the exception of the MIRCO model for years 2001 to 2030 at Flowerdale; Figure 4a).

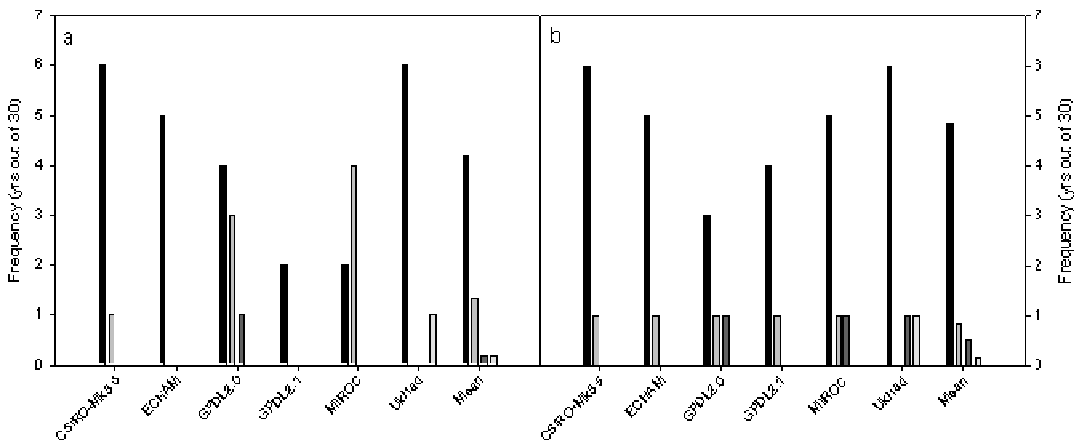

Figure 4. Frequency (number of years out of 30) of short spring seasons at Flowerdale (a) and Ringarooma (b) for six general circulation models for the periods of years 1971 to 2000 (■), 2001 to 2030 (□), 2031 to 2060 (■) and 2061 to 2090 (□).

At Flowerdale and Ringarooma, the frequency of long springs, as a mean of the six GCMs, was predicted to remain relatively stable across all climate periods at between 29% and 32% (i.e. between 8.7 and 9.7 years out of 30) for Flowerdale (Figure 5a) and between 26% and 31% (i.e. between 7.8 and 8.5 years out of 30) for Ringarooma (Figure 5b).

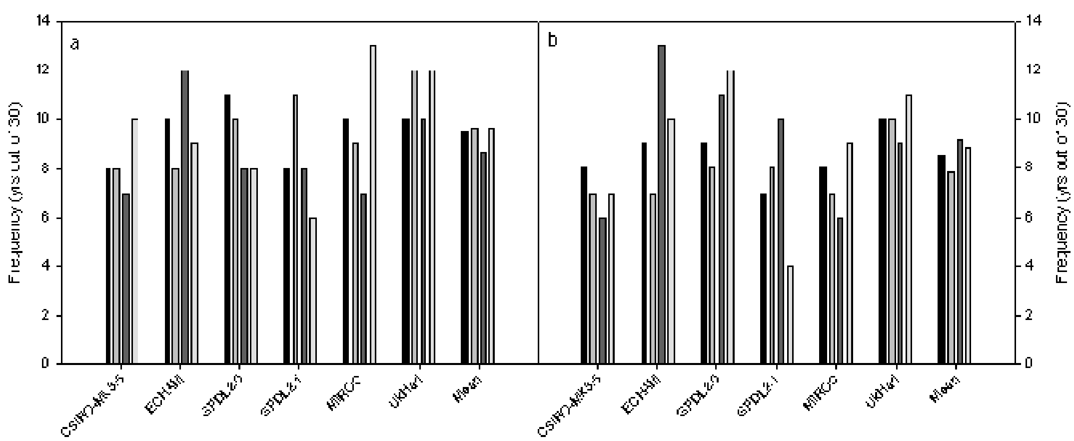

Figure 5. Frequency (number of years out of 30) of long spring seasons at Flowerdale (a) and Ringarooma (b) for six general circulation models for the periods of years 1971 to 2000 (■), 2001 to 2030 (□), 2031 to 2060 (■) and 2061 to 2090 (□).

Conclusion

This study has indicated that it is likely that the mean frequency of early autumn breaks, as defined within this study, for both regions of Flowerdale and Ringarooma would increase into the future.

There is also a corresponding likelihood that the mean frequency of late autumn breaks will decline in the future for the two regions. Increases in PGR above the historical average PGR for the months of March and April could lead to farmers considering autumn only or split calving (i.e. autumn and spring) in these environments. This study also concluded that while the mean frequency of long springs, as defined in this study, was unlikely to change dramatically in the future, the mean frequency of short springs was predicted to decline substantially in the future. This predicted increase in early spring season growth was mostly likely a result of warmer temperatures, higher levels of atmospheric CO_2 and minimal changes in precipitation, leading to more consistent PGR for the spring period. An increased frequency of an early autumn break and a more consistent spring pasture growth may promote management changes, such as earlier calving times or increased stocking rates, to take advantage of any increase in the length of the pasture growing season.

References

Australian Bureau of Meteorology (2008). Australian Climate Change and Variability. http://reg.bom.gov.au/climate/change/aus_cvac.shtml

Chapman DF, Kenny SN, Beca D, Johnson IR (2008). Pasture and forage crop systems for non-irrigated dairy farms in southern Australia. 2. Inter-annual variation in forage supply, and business risk. *Agricultural Systems* **97**, 126-138.

Corney SP, Katzefey JJ, McGregor JL, Grose MR, Bennet JB, White CJ, Holz GK, Gaynor SM and Bindoff NL (2010). Climate Futures for Tasmania: climate modelling technical report. Antarctic Climate and Ecosystems Cooperative Research Centre, Hobart.

Gallant AJE, Hennessy KH and Risbey J (2007). Trends in rainfall indices for six Australian regions: 1910-2005. *Australian Meteorological Magazine* **56**, 223-239.

Grose MR, Barnes-Keoghan I, Corney SP, White CJ, Holz GK, Bennett JB, Gaynor SM and Bindoff NL (2010). Climate Futures for Tasmania general climate impacts technical report. Antarctic Climate and Ecosystems Cooperative Research Centre, Hobart, Tasmania.

Johnson IR, Chapman DF, Snow VO, Eckard RJ, Parsons AJ, Lambert MG and Cullen BR (2008). DairyMod and EcoMod: biophysical pasture-simulation models for Australian and New Zealand. *Australian Journal of Experimental Agriculture* **48**, 621-631.

This study was supported by funding from Dairy 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.