Appendix A.

Resistance of pasture production to projected climate changes in south-eastern Australia

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Abstract. Climate change impact analysis relies largely on down-scaling climate projections to develop daily time-step, future climate scenarios for use in agricultural systems models. This process of climate down-scaling is complicated by differences in projections from greenhouse gas emission pathways and, in particular, the wide variation between global climate model outputs. In this study, a sensitivity analysis was used to test the resistance of pasture production to the incremental changes in climate predicted over the next 60 years in southern Australia. Twenty-five future climate scenarios were developed by scaling the historical climate by increments of 0, 1, 2, 3 and 4oC (with corresponding changes to atmospheric carbon dioxide concentrations and relative humidity) and rainfall by +10, 0, –10, –20 and –30%. The resistance of annual and seasonal pasture production to these climatic changes was simulated at six sites in south-eastern Australia. The sites spanned a range of climates from high rainfall, cool temperate in north-west Tasmania to the lower rainfall, temperate environment of Wagga Wagga in southern New South Wales. Local soil and pasture types were simulated at each site using the Sustainable Grazing Systems Pasture model. Little change or higher annual pasture production was simulated at all sites with 1oC warming, but varying responses were observed with further warming. In a pasture containing a C4 native grass at Wagga Wagga, annual pasture production increased with further warming, while production was stable or declined in pasture types based on C3 species in temperate environments. In a cool temperate region pasture production increased with up to 2oC warming. Compared with the historical baseline climate, warmer and drier climate scenarios led to lower pasture production, with summer and autumn growth being most affected, although there was some variation between sites. At all sites winter production was increased under all warming scenarios. Inter-annual variation in pasture production, expressed as the coefficient of variation, increased in the lower rainfall scenarios where production was simulated to decline, suggesting that changing rainfall patterns are likely to affect the variability in pasture production more than increasing temperatures. Together the

results indicate that annual pasture production is resistant to climatic changes of up to 2oC warming. The approach used in this study can be used to test the sensitivity of agricultural production to climatic changes; however, it does not incorporate changes in seasonal and extreme climatic events that may also have significant impacts on these systems. Nonetheless, the approach can be used to identify strategies that may increase resilience of agricultural systems to climate change such as the incorporation of C4 species into the pasture base.

See Cullen BR, Eckard RJ, Rawnsley RP (2012) Resistance of pasture production to projected climate changes in south-eastern Australia. Crop and Pasture Science 63, 77-86. doi:10.1071/CP11274