Likely changes to livestock.

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Methodology of project

- Using GrassGro
- Daily weather achieved by downscaling from GCM. Program developed (Weather maker) by Andrew Moore from CSIRO.

  4 GCM used, based on M skill score from Climate Change in Australia- technical report 2007.
  ECHAM5, HADGEM1,NCAR-CCSM, GFDL2.1.
  All use with A2 scenario

GrassGro

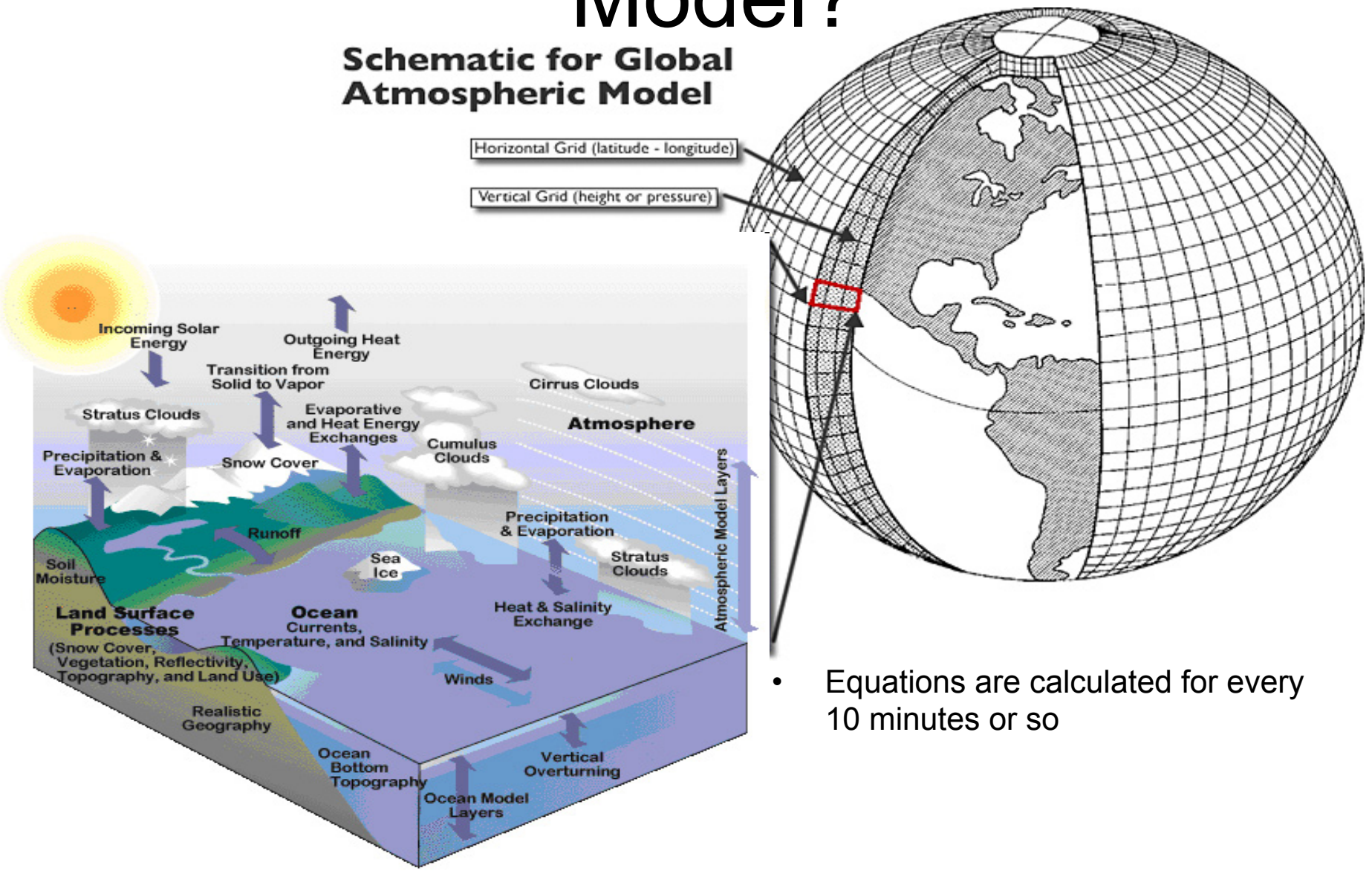
Project logic

- Select town and app weather and soil data.
- Run livestock enterprise for 1970 to 2000 to establish base data – physical, $, environmental. We have set a limit on ground cover (70% of yrs min GC to be above 70%). This establishes the stocking rate.
- Run for 2000 to 2009 for recent reference pt.

Project logic

- Run exactly the same system except change the daily weather data to 30 yrs of 2030 outputs and increase CO2 to 444.
- Run this for the 4 GCM
- Use same GC rule to establish the new stocking rates for each GCM.
- Look at impact and test adaptations

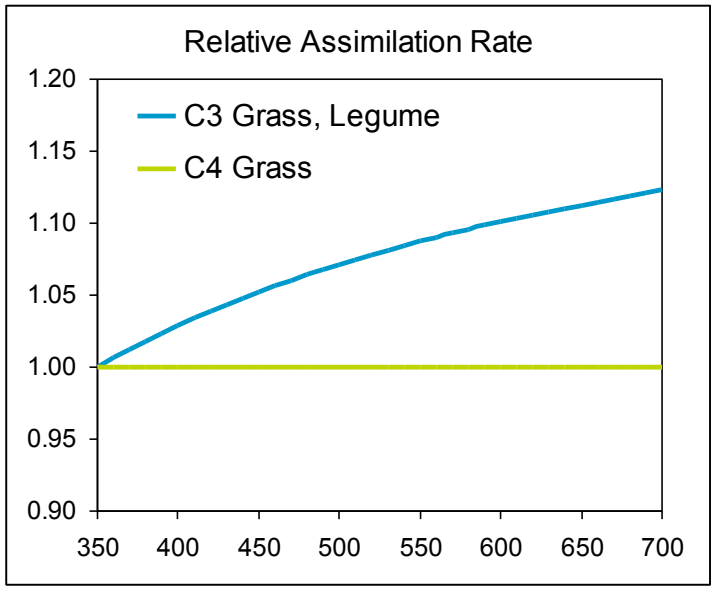
What is a Global Climate Model?



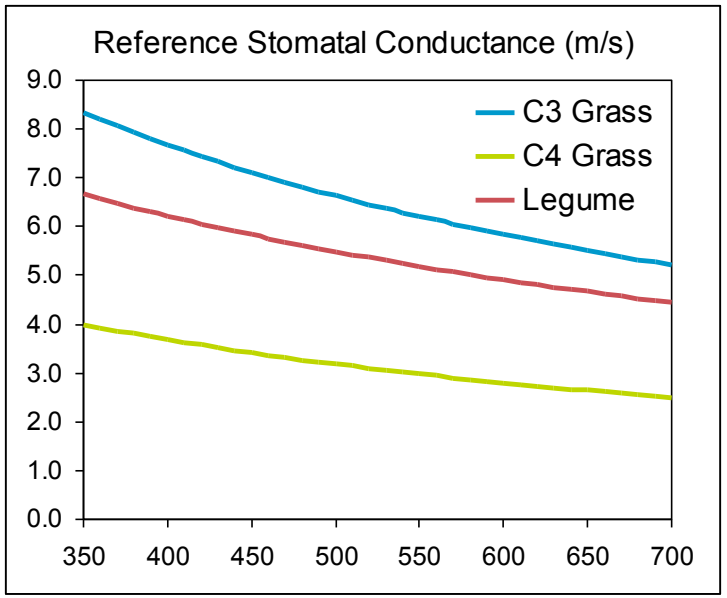
- Equations are calculated for every 10 minutes or so

Impact of increased CO2 on plant production

Leaf Photosynthesis

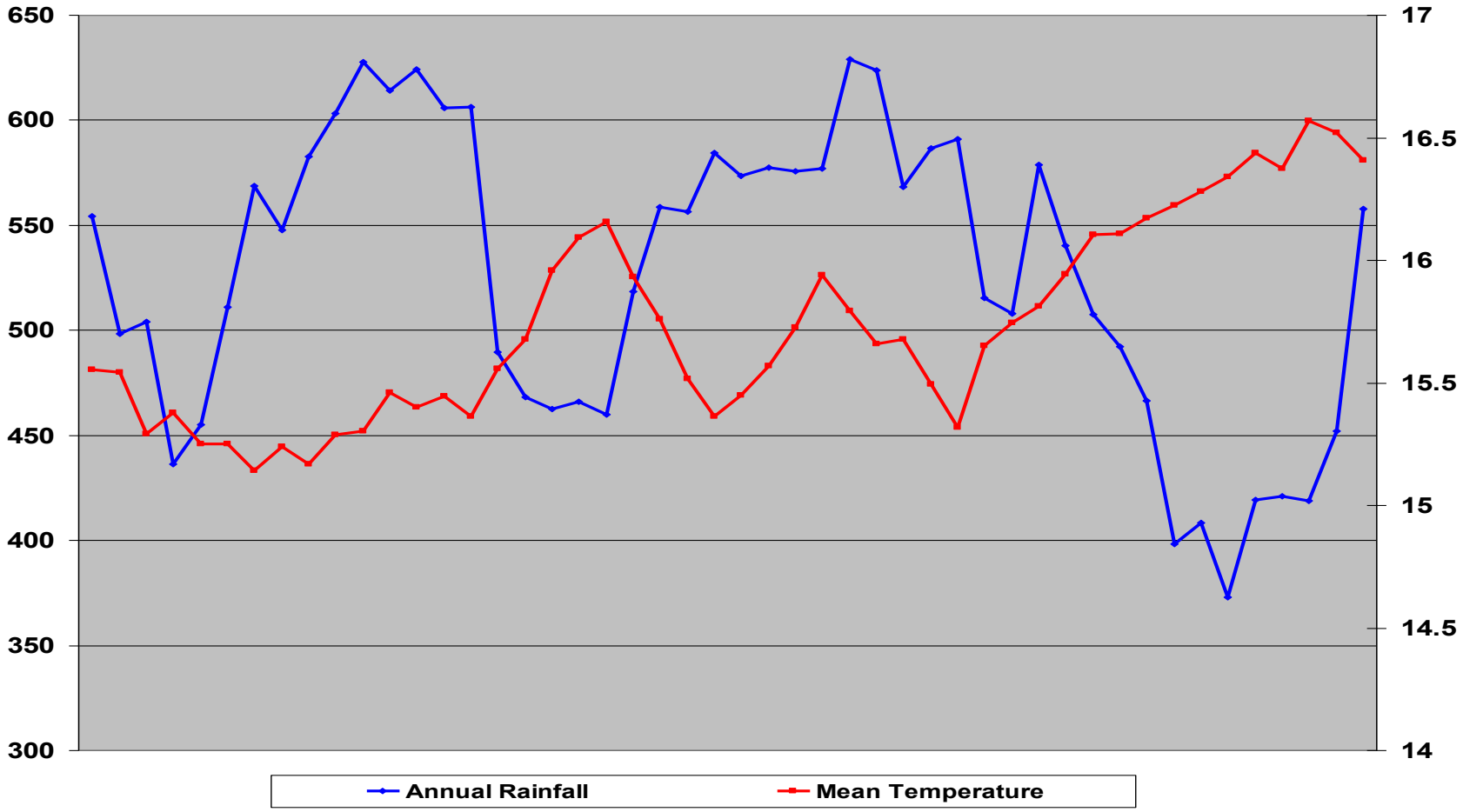


Leaf Water Loss



- Larger increase in net growth
- Smaller reduction in canopy transpiration rate
- 10% decrease in N content (per unit leaf area) of grasses

Mean Temperature and annual rainfall 1960 to 2011



Temora 20 um self replacing merino

Pasture type **Annual grass, sub clover and lucerne**

	1970–1999	2000-2009	2030 Climate Scenario 1	2030 Climate Scenario 2	2030 Climate Scenario 3	2030 Climate Scenario 4
Rainfall (mm/pa)	559	408	508	458	560	528
Temperature (°C average)	15.7	16.4	17.0	17.1	17.0	16.7
Pasture (kg DM/Ha/yr)	5752	3978	5081	4452	5345	6099
Stock Rate (DSE/Ha)	7.6	6.9	6.2	4.4	6.8	8.9
Profit ($/ Ha)	86	29	48	-2	66	118
Profit change compared to 1970 - 1999		- 66%	- 43%	- 82%	- 23%	+37%

Note:
2030 Climate Scenario 1 - GFDL (USA 1)
2030 Climate Scenario 2 – ECHAM (German)
2030 Climate Scenario 3 – CCSM (USA 2)
2030 Climate Scenario 4 – HAD (English)

Narrandera self replacing merino

Pasture type **Annual grass and sub clover**

	1970–1999	2000-2009	2030 Climate Scenario 1	2030 Climate Scenario 2	2030 Climate Scenario 3	2030 Climate Scenario 4
Rainfall (mm/pa)	495	383	441	399	486	475
Temperature (°C average)	16.5	17.0	17.8	18.0	17.7	17.6
Pasture (kg DM/Ha/yr)	6782	4779	4658	4482	5184	6507
Stock Rate (DSE/Ha)	5.9	4.3	2.4	2.4	2.5	5.1
Profit ($/ Ha)	82	31	-6	-8	1	60
Profit change compared to 1970 - 1999		- 62%	-107%	-109%	-88%	- 27%

GCMs 2006 vs 2011 for the time period 2030

	GCM	Rain mm	Mean Temp	Dse/ha	Profit/ha
Temora	1	**514**	**17**	**6.6**	**58**
	2	**537**	**17**	**7.1**	**73**
Holbrook	1	**610**	**16.2**	**11.4**	**144**
	2	**652**	**16.3**	**10.6**	**124**
Grenfell	1	**553**	**17.2**	**6.6**	**47**
	2	**578**	**17.3**	**6.5**	**54**
Cootamundra	*1*	**615**	**15.7**	**10.1**	**135**
	2	**649**	**16.0**	**9.5**	**107**

Pasture production within seasons

	Holbrook	Crookwell	Temora
	GCM2 vs History	GCM2 vs History	GCM2 vs History
Spring	44% vs 50%	41% vs 43%	39% vs 46%
Summer	8% vs 6%	18% vs 20%	19% vs 17%
Autumn	19% vs 19%	25% vs 26%	18% vs 16%
Winter	31% vs 23%	15% vs 10%	25% vs 21%

Temora – impact of management areas

Adaptations modelled	Profit ($/ Ha) 1970–1999	Profit ($/ Ha) 2030 Average of 4 GCMs	Profit ($/ Ha) 2030 as a % of 1970-99
1.Business as usual	86	**58**	**67 %**
1.Summer feedlot – grain $240/t on farm		**61**	**71 %**
1.Summer feedlot – grain $210/t on farm		**71**	**83 %**

Narrandera

Adaptations modelled	Profit ($/ Ha) 1970–1999	Profit ($/ Ha) 2030 Average of 4 GCMs	Profit ($/ Ha) 2030 as a % of 1970-99
1. Business as usual	82	11.75	14% **(66%)**
1. Use summer feedlot – cost of grain included		20	24%
1. Ensure genetic gain from now to 2030- + 1 kg flc wt, -0.8um		29	35%
1. Combine the genetics and feedlot		47	57%
1. Business as usual – Prime lambs	139	38	27%
1. Decrease lamb turn off time and increase dressing % by 2 %		48	35%

Summary

- Pasture are going to come under pressure from increased temperatures and decrease soil water.
- This will put downward pressure on stocking rates.
- Perennials in pastures will provide more of a buffer than annuals.
- Hard seed will become more important for annuals.
- The impact on the sowing time of grazing crops will be just as important as pasture changes to the feed supply.
- Improving profit per head will become more important in the future – applies to sheep and cattle.