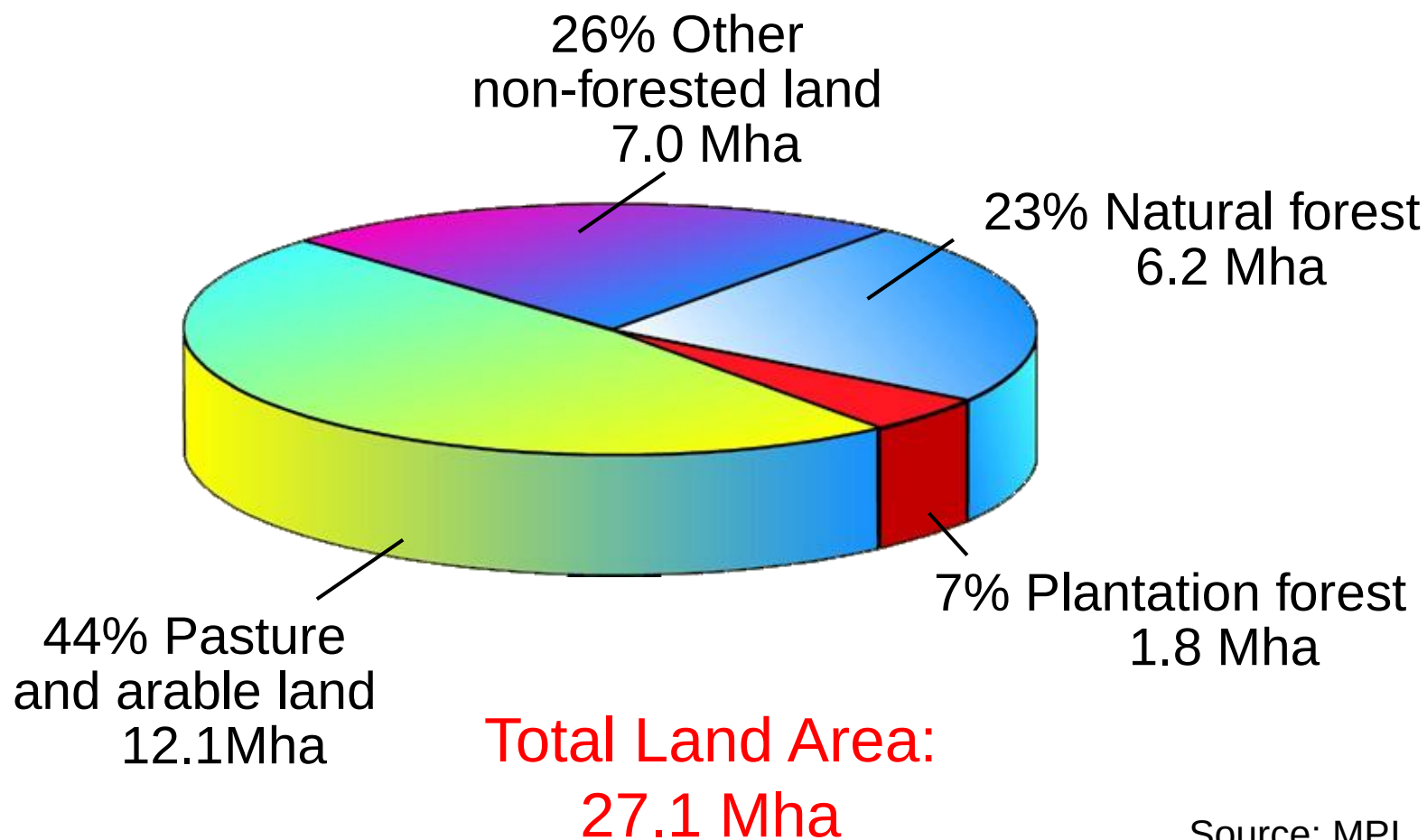


Exploring *Eucalyptus fastigata* growth with 3PG projections in New Zealand under different climate scenarios

Dean F Meason, João HN Palma, Duncan Harrison, and David Palmer



New Zealand's Land Use



Source: MPI



Composition of New Zealand's commercial forests

- *Pinus radiata* – 90%
- *Pseudotsuga menziesii* – 5%
- Other species – 5%. Including:
 - *Cupressus* species
 - *Eucalyptus* species
 - *Sequoia sempervirens*



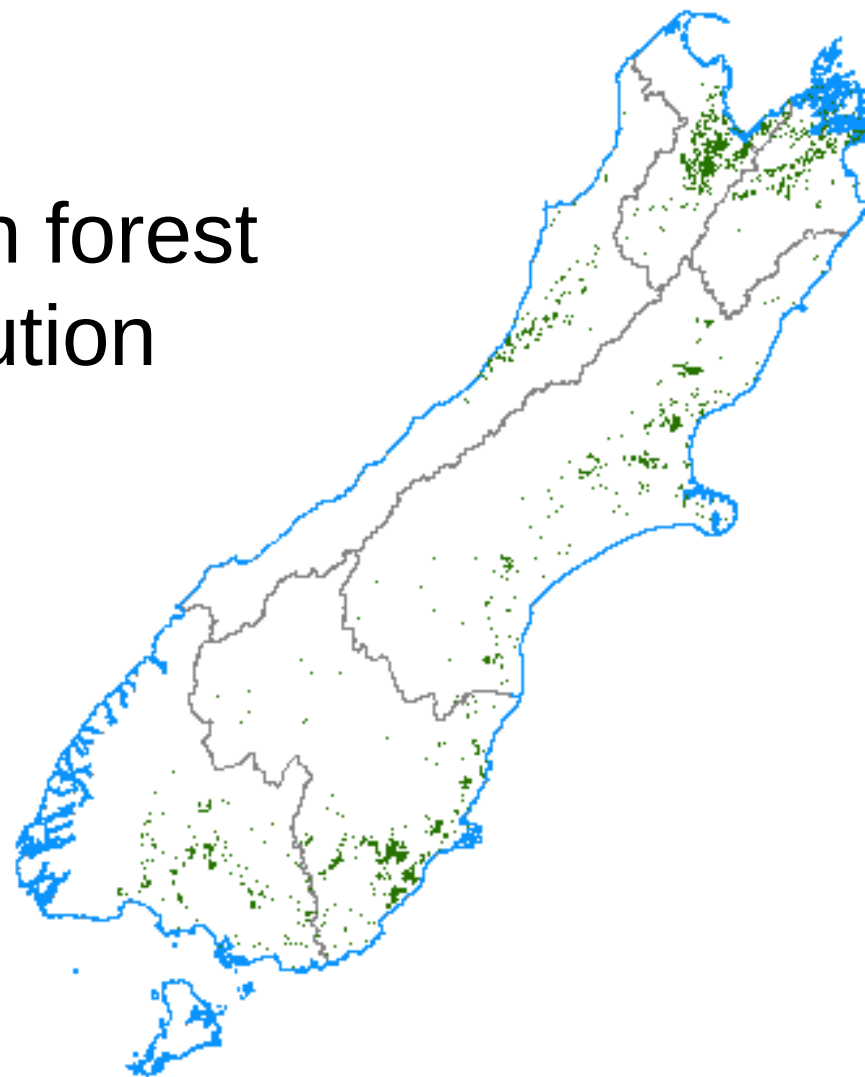
Legend

- nt_pine2666_forested
- Coastline
- Regions

Legend

- Coastline
- Plantations
- Regions

Plantation forest distribution



Eucalyptus fastigata



- Low to mid elevation mountain species from South-Eastern Australia
- Able to tolerate a wide range of NZ environments
- Resistant to eucalypt pathogens
- Valuable for timber, pulp, or carbon forest species

Marginal agricultural land



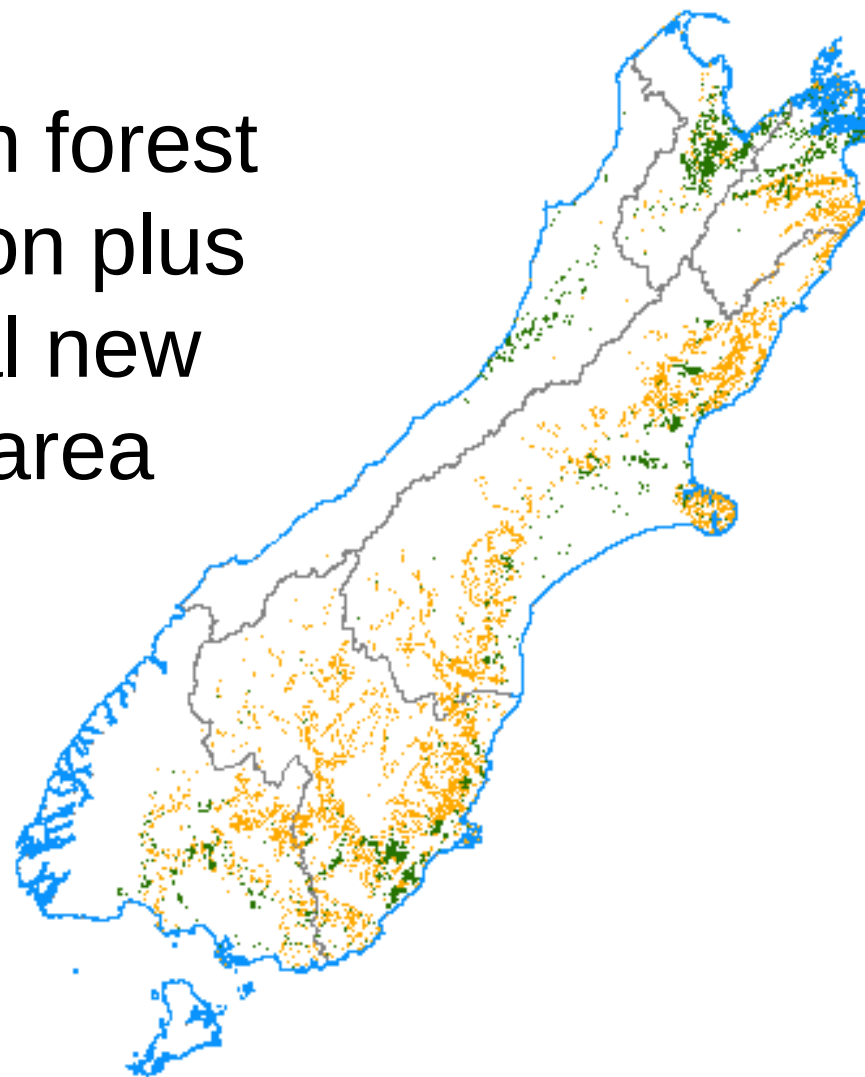
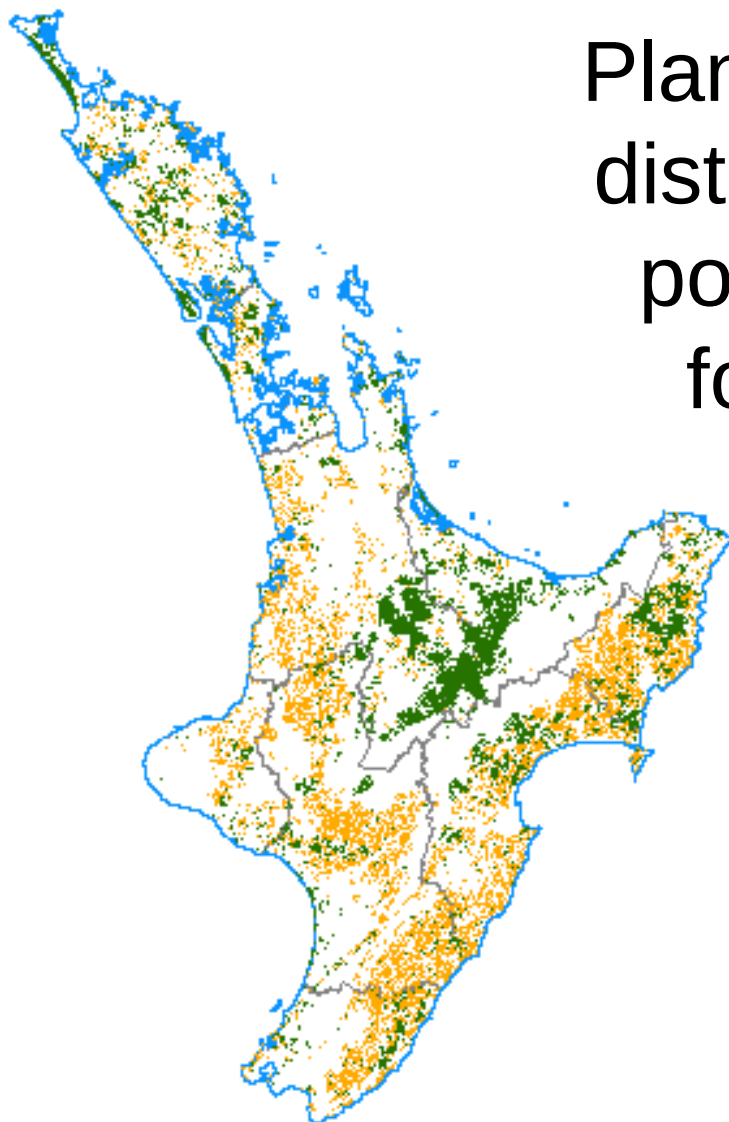
Legend

- Buildable for conversion
- nt_pine_05266_01forestled
- Coastline
- Regions

Legend

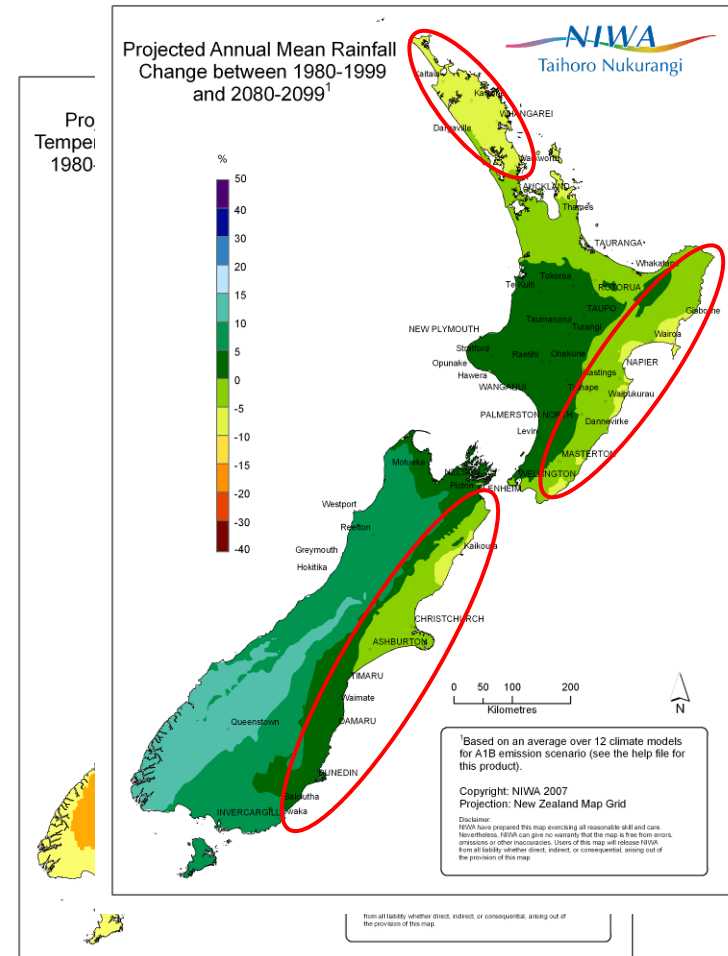
- Coastline
- Buildable for conversion
- Plantations
- Regions

Plantation forest
distribution plus
potential new
forest area



Climate Change in New Zealand

- Temperature rises
 - 1.6 to 2.0°C in 2080
- Rainfall changes
 - +/-10 to 15% in 2080
- High variability and uncertainty



Objectives

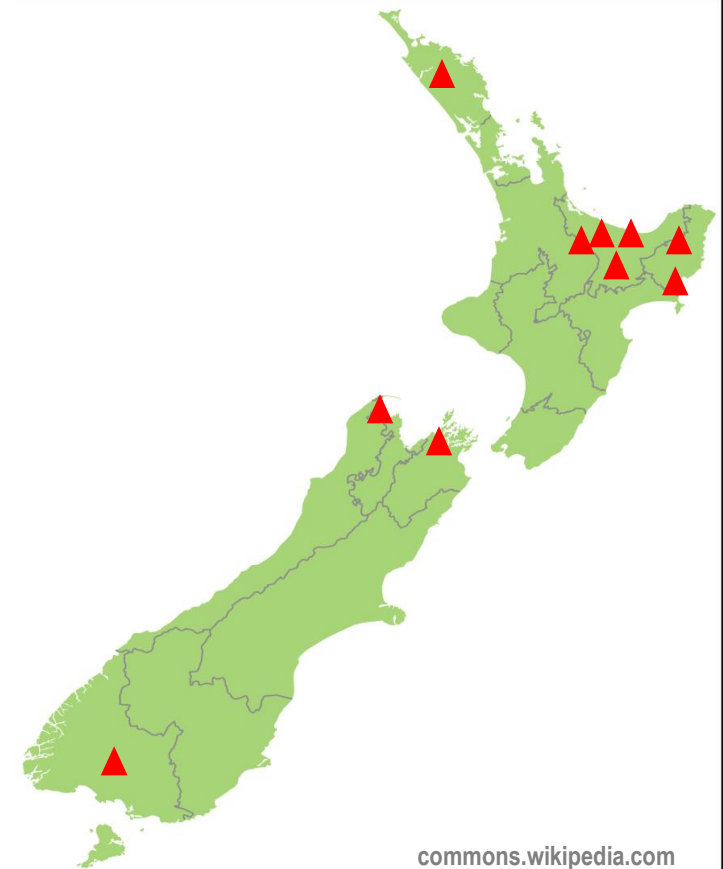
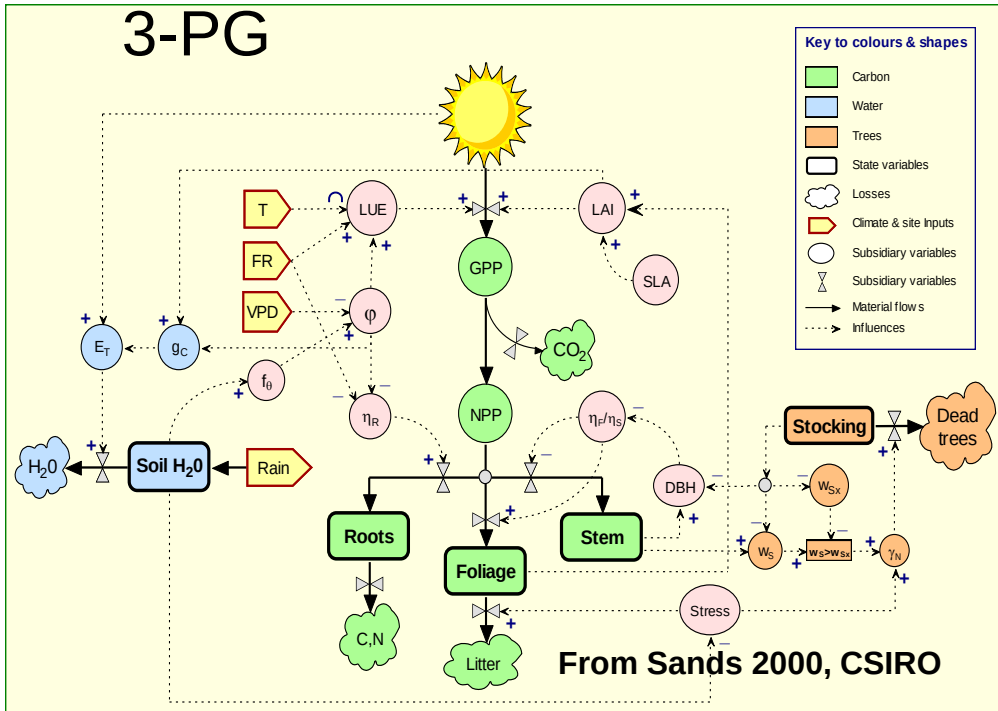
- Analyse the potential impact of climate change (CC) on *E. fastigata* productivity
- Determine which environmental factors have the greatest impact
- Determine the sensitivity of *E. fastigata* to decreasing rainfall and shallow soils
- Identify which management strategies are most appropriate for CC

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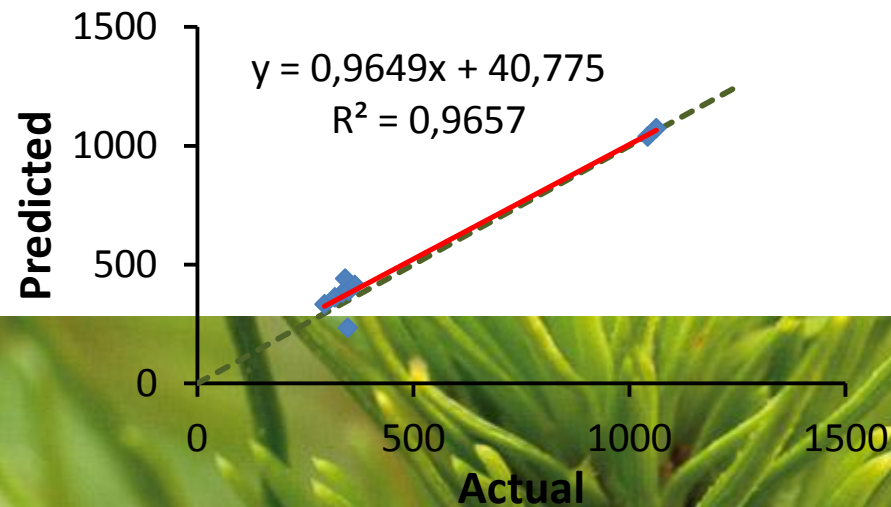
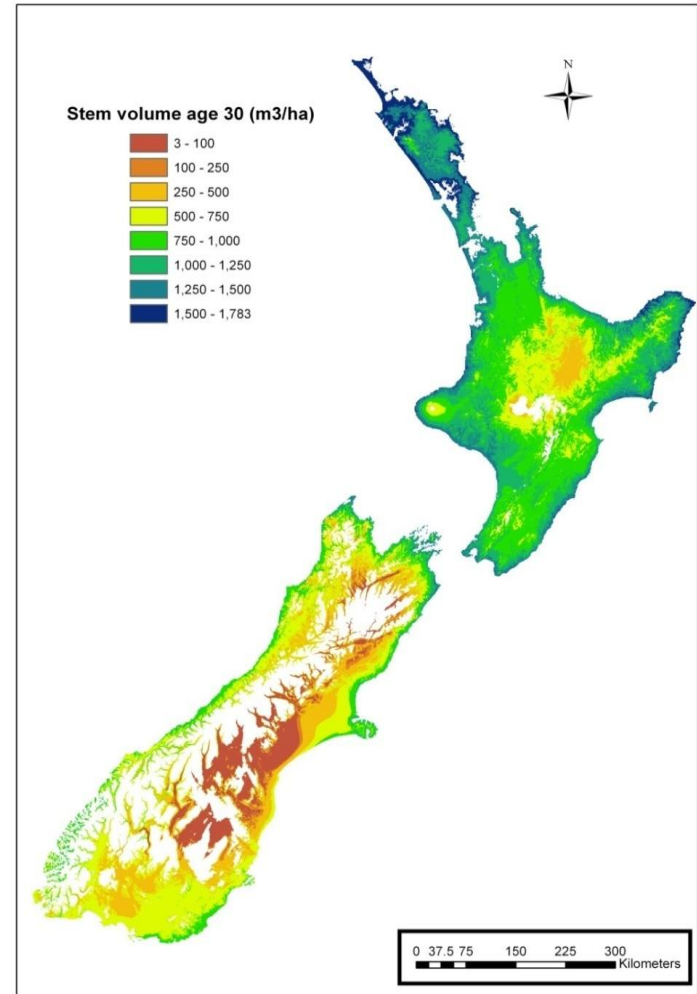
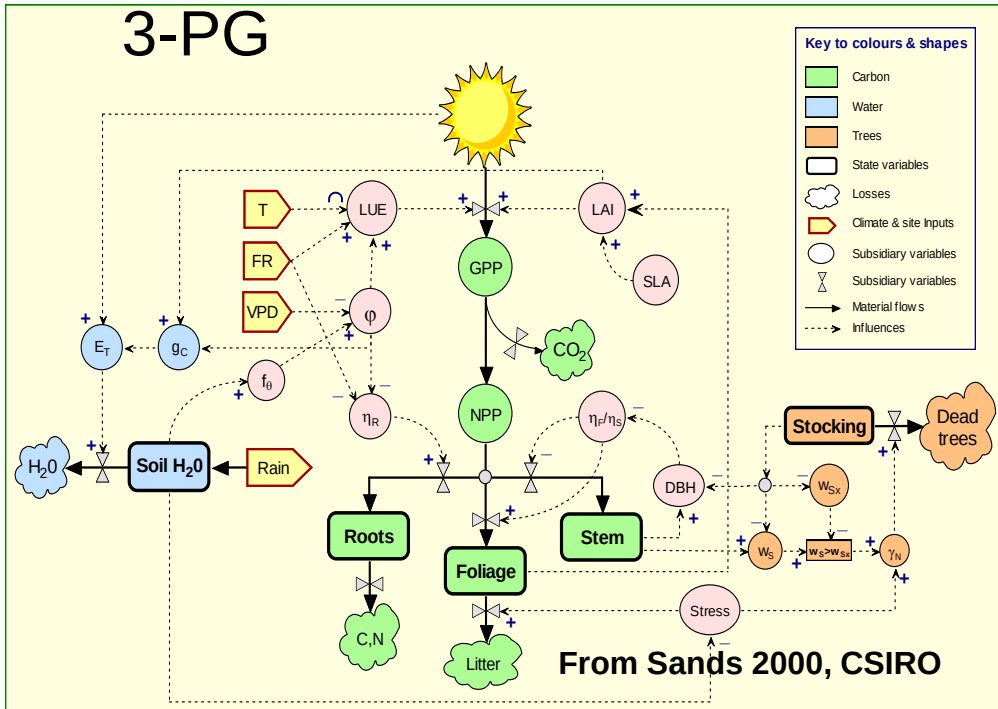
3-PG parameterisation for *Eucalyptus fastigata*

3-PG

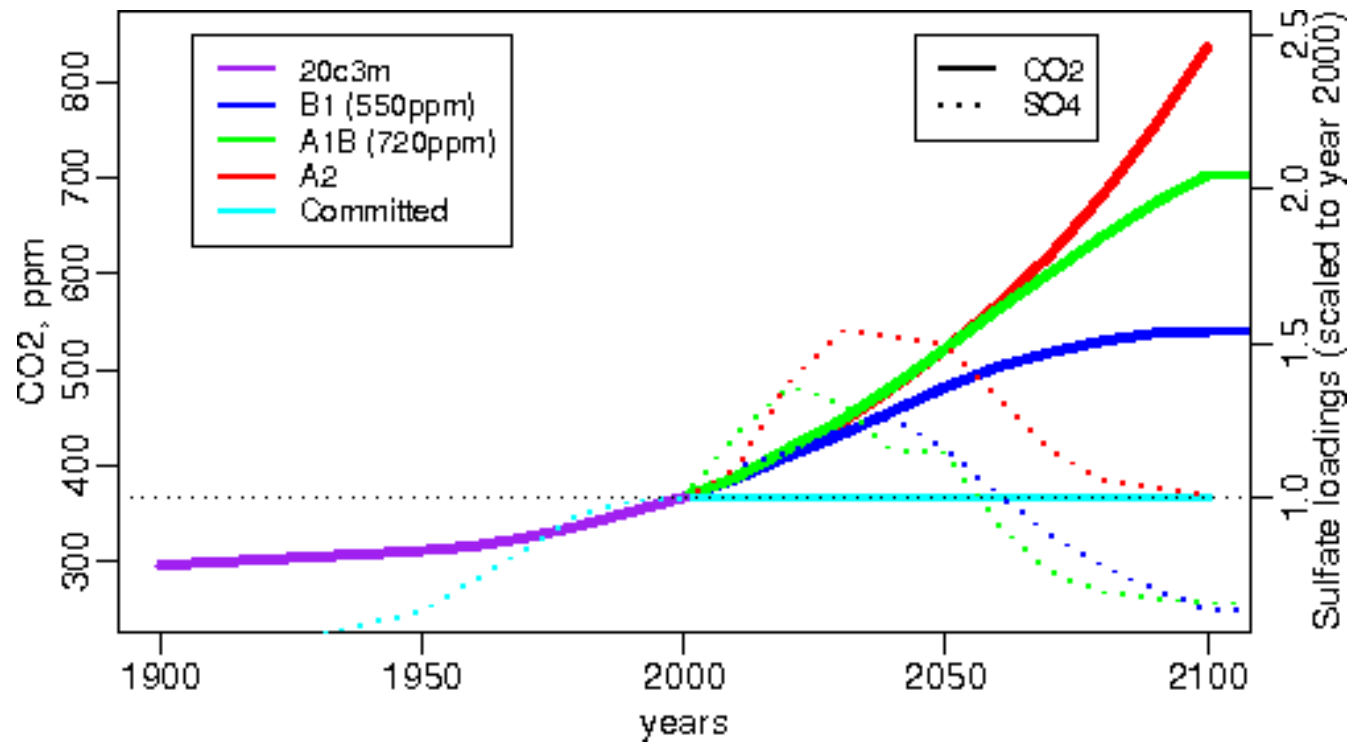


3-PG parameterisation for *Eucalyptus fastigata*

3-PG



IPCC Special Report on Emissions Scenarios (SRES)



www.cccma.ec.gc.ca



CC modelling process

CCCma CGCM3 SRES scenarios B1, A1B, and A2

CGCM3 downscaling by NIWA: % change from 1980-1999 mean climate on 0.05° grid

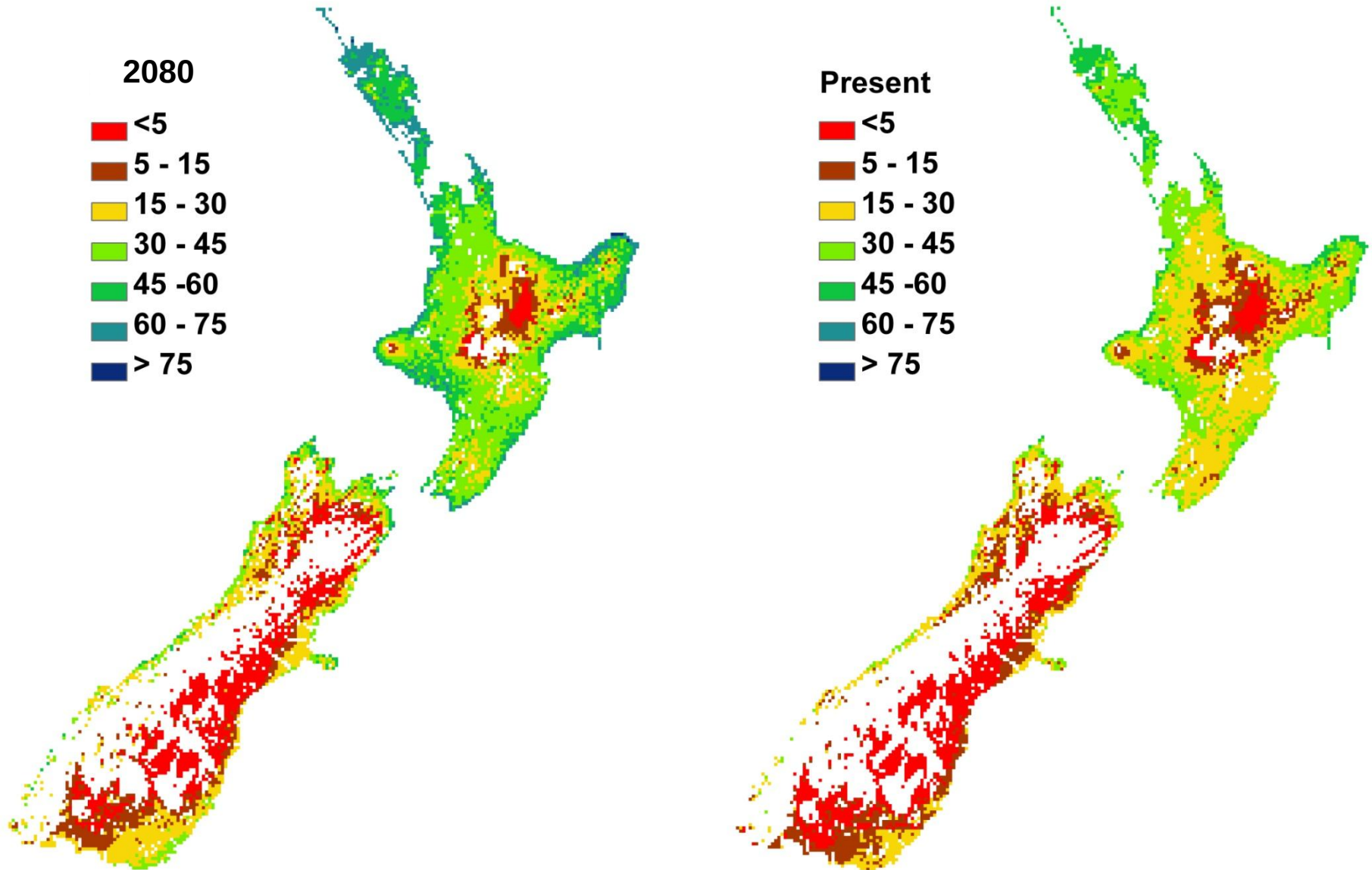
Current monthly mean max & min temp, total rainfall, and frost days reprocessed by CC scenario

Spatial CC data added to 3-PG Spatial on 5km grid

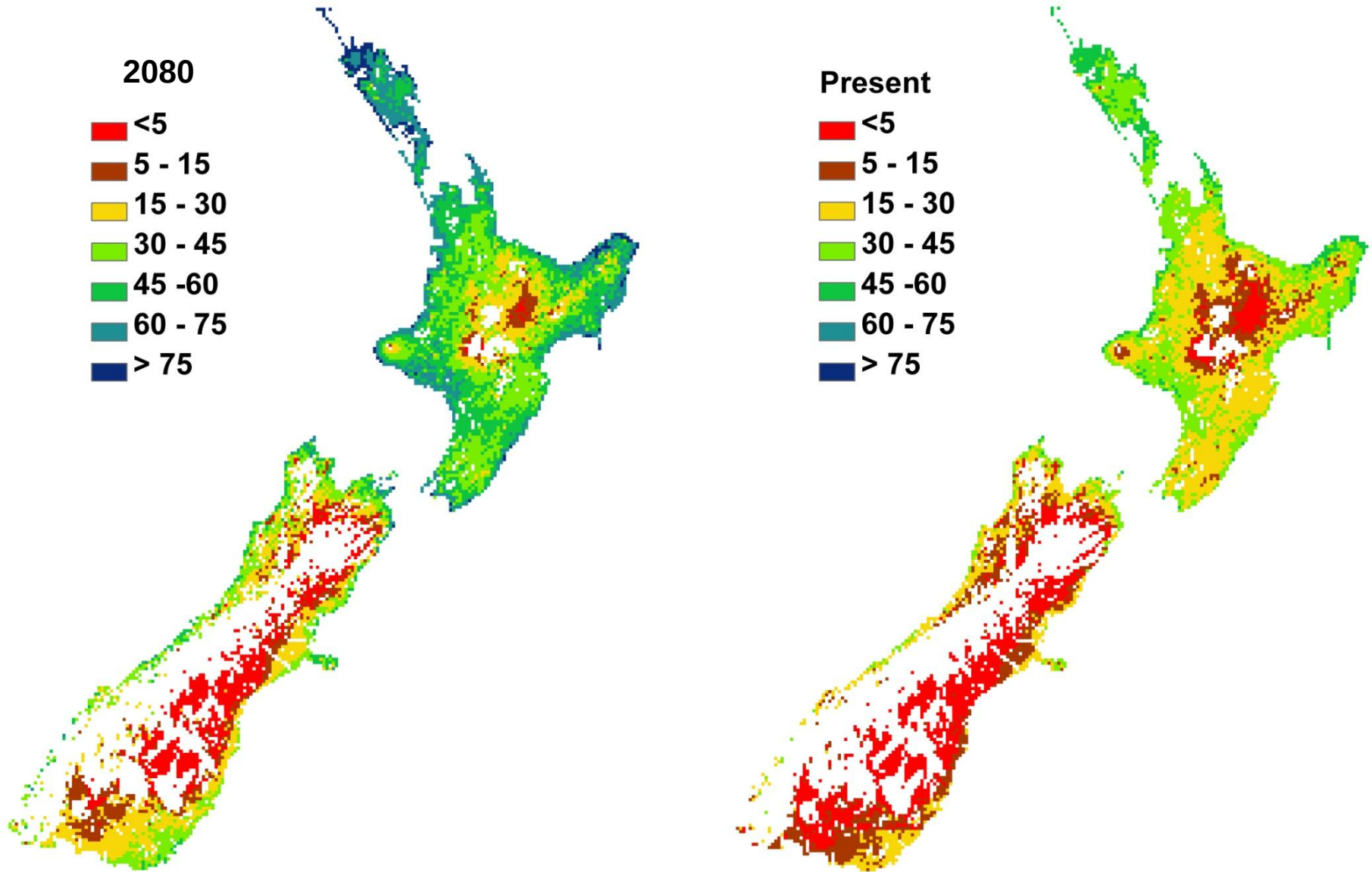
E. fastigata productivity management scenarios



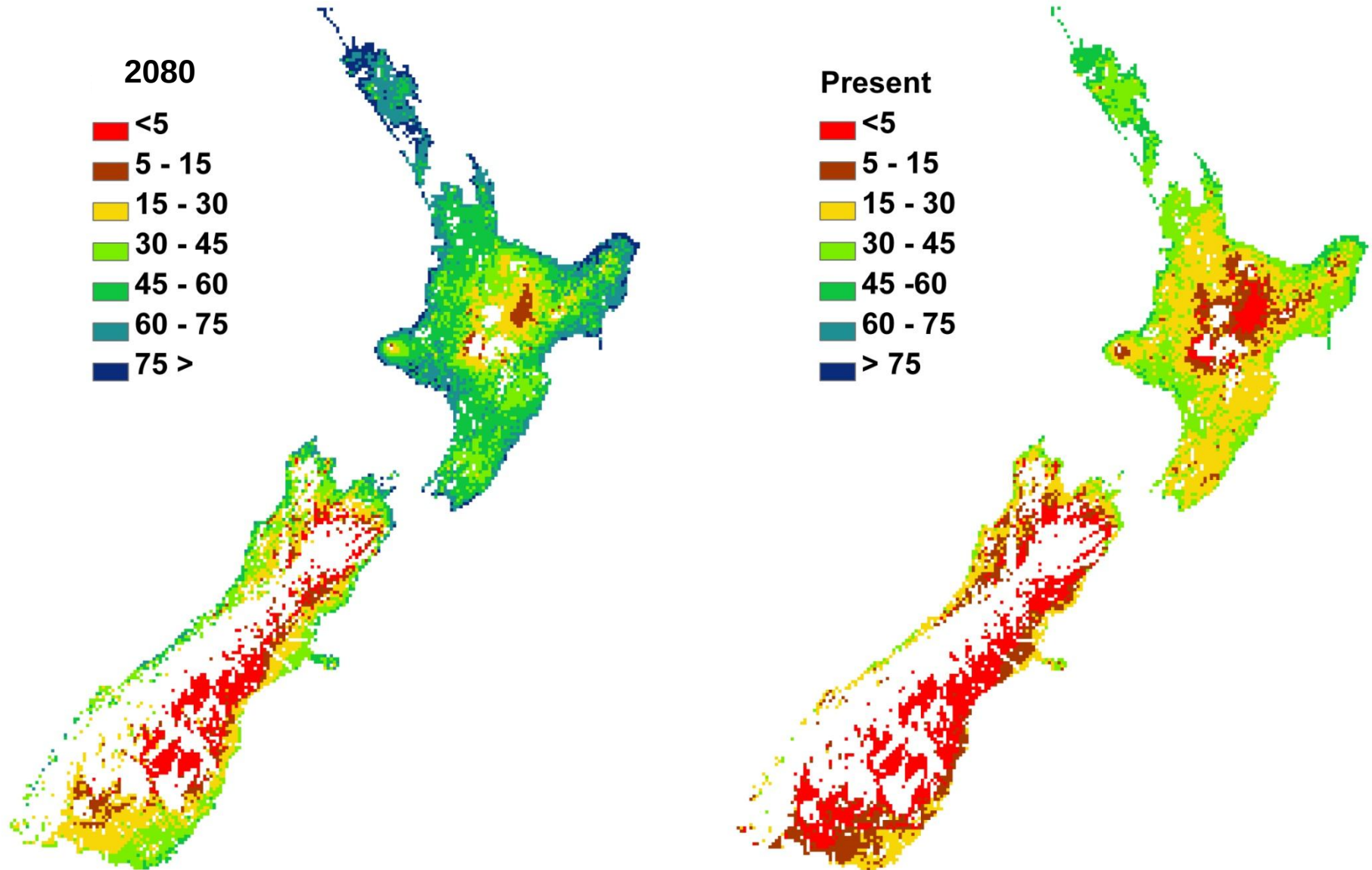
Scenario B1 2080 – Mean annual increment ($\text{m}^3 \text{ha}^{-1} \text{yr}^{-1}$)



Scenario A1B 2080 – Mean annual increment ($\text{m}^3 \text{ha}^{-1} \text{yr}^{-1}$)



Scenario A2 2080 – Mean annual increment ($\text{m}^3 \text{ha}^{-1} \text{yr}^{-1}$)



CO₂ fertilisation effect

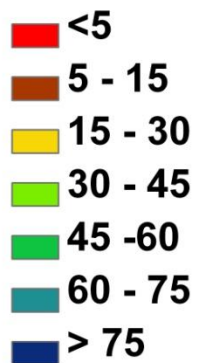
- Photosynthesis is enhanced with increased CO₂ concentration
 - Typically cited value ~ 20% increase
- Unclear if enhanced photosynthesis = long term increase in net primary productivity
- How does it influence CC simulations?



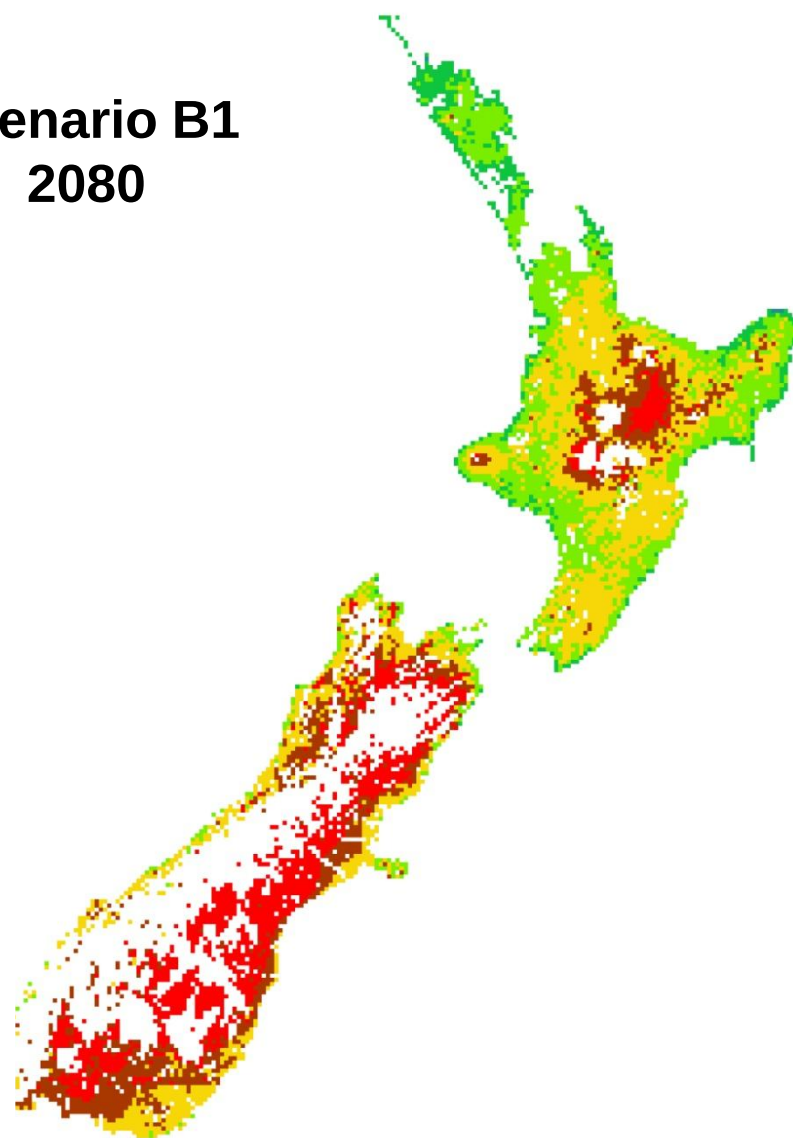
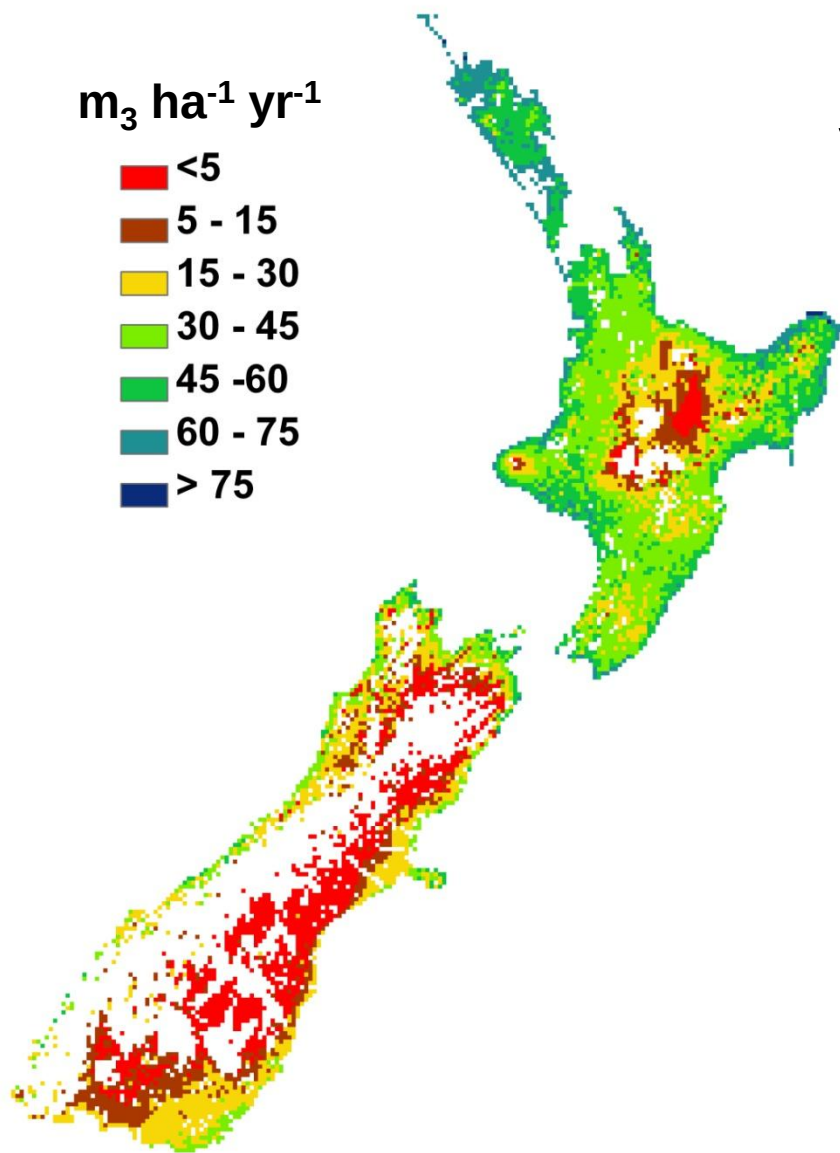
CO₂ Fertilisation

No CO₂ Fertilisation

$m_3 \text{ ha}^{-1} \text{ yr}^{-1}$



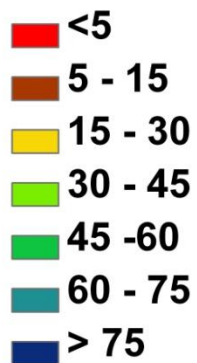
Scenario B1
2080



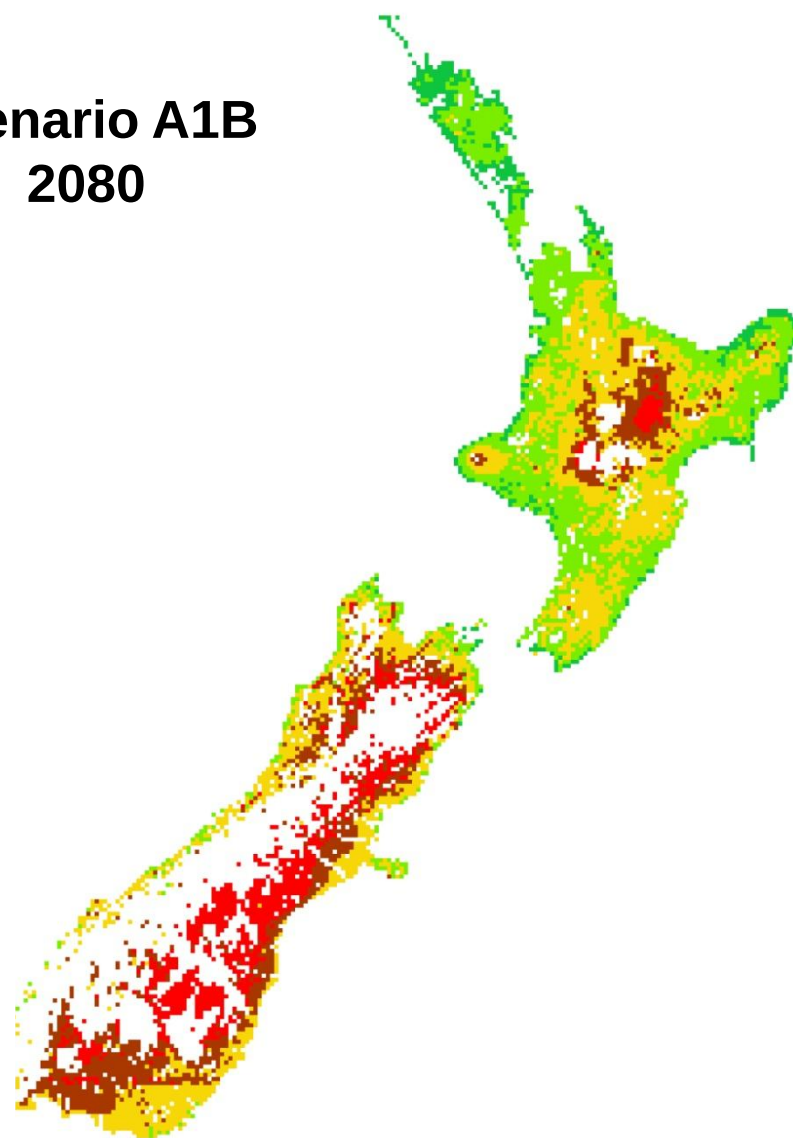
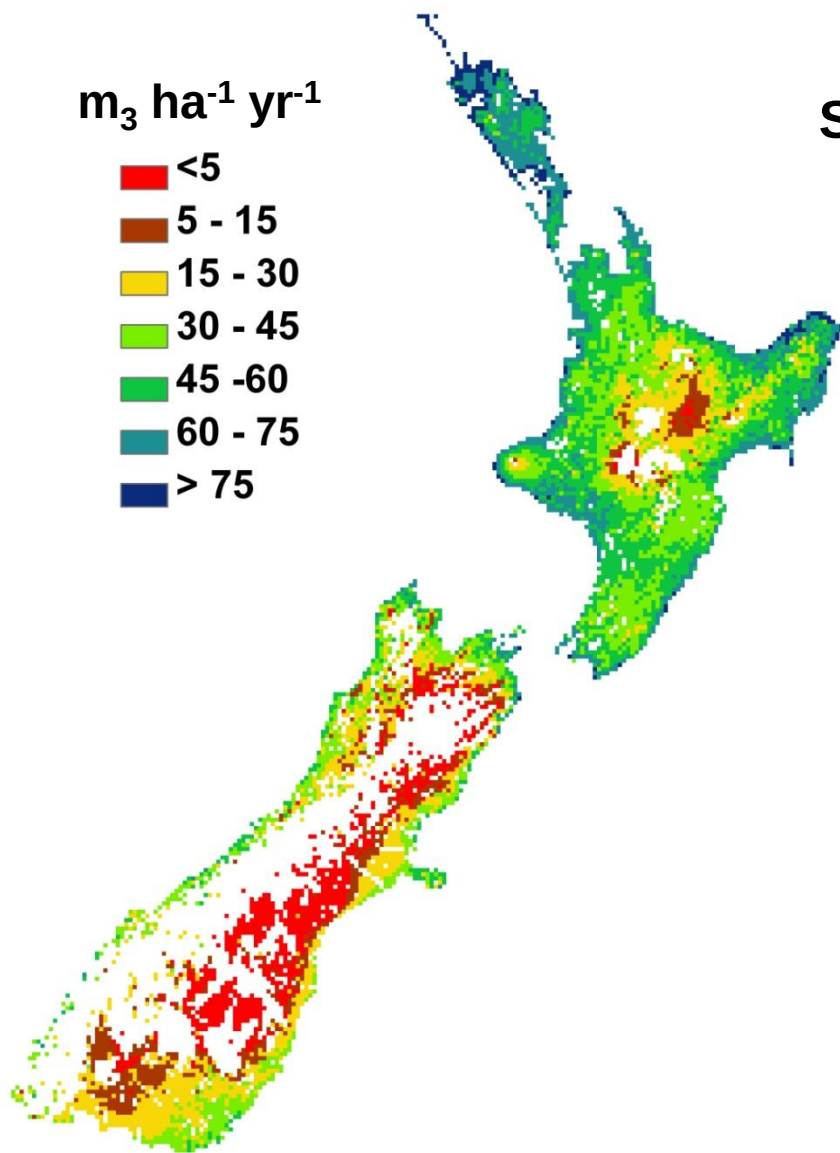
CO₂ Fertilisation

No CO₂ Fertilisation

$m_3 \text{ ha}^{-1} \text{ yr}^{-1}$



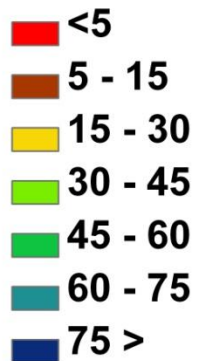
Scenario A1B
2080



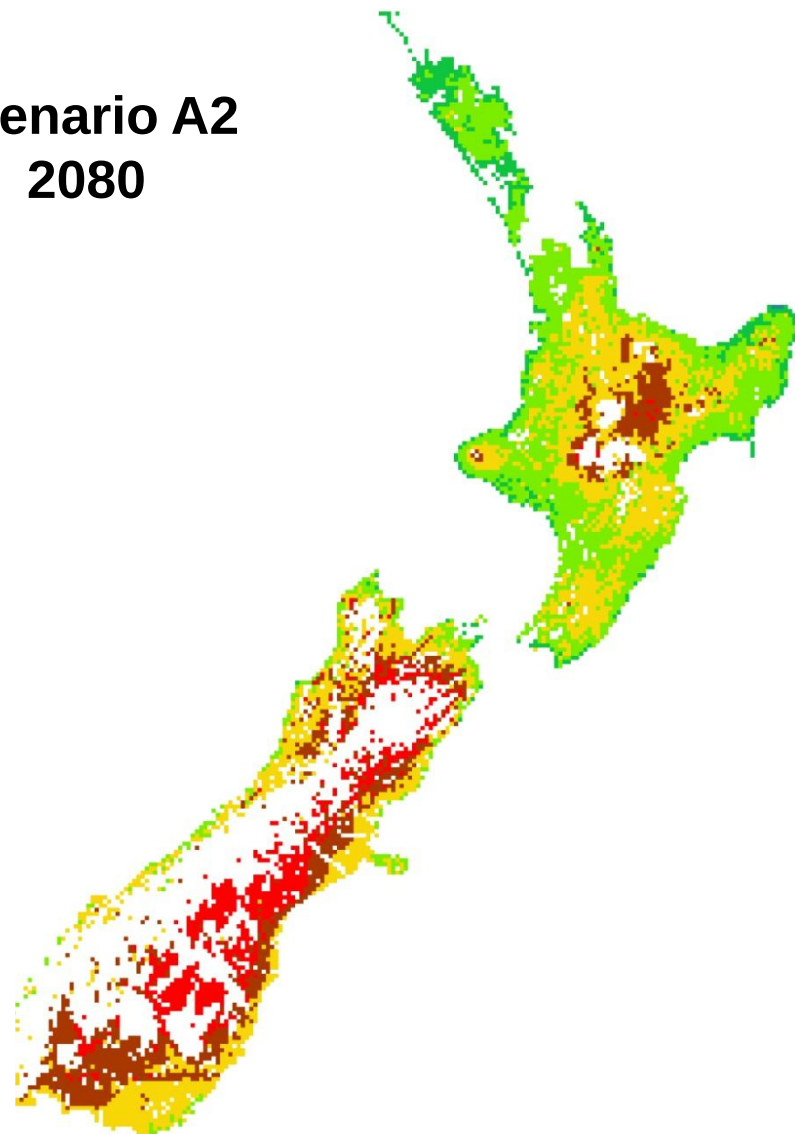
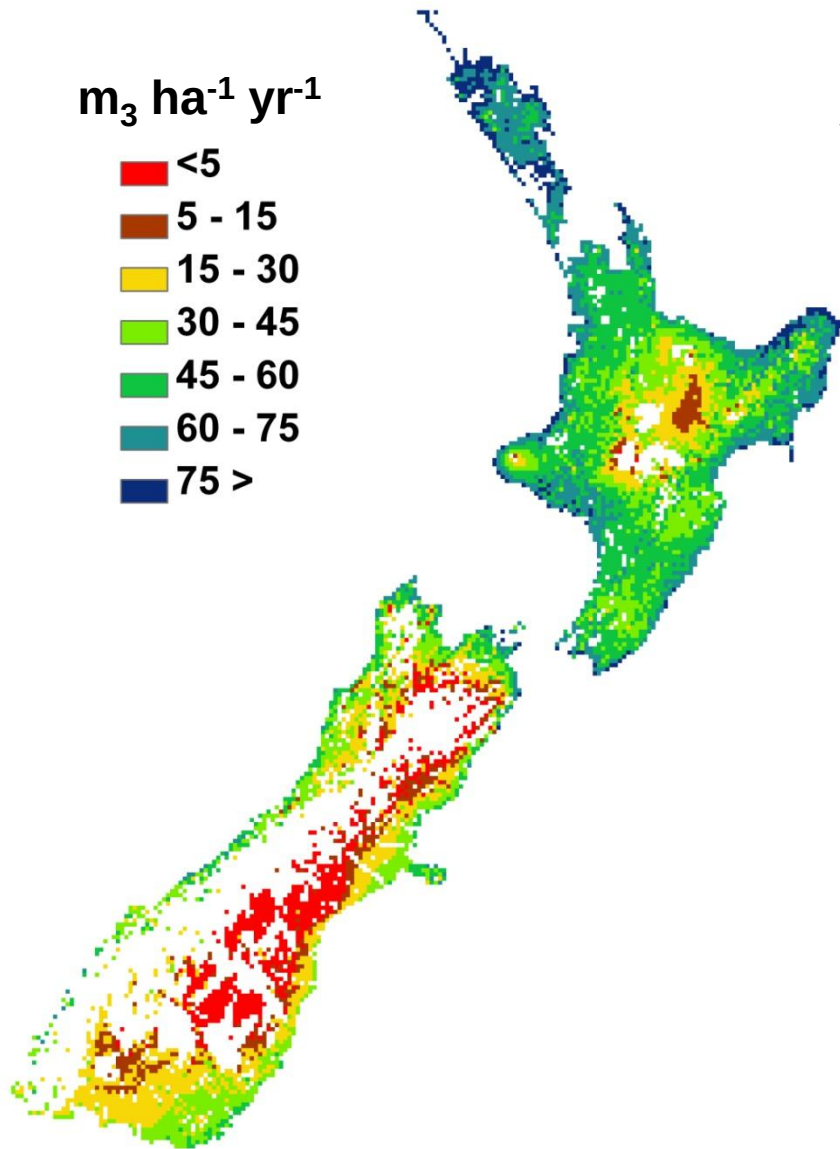
CO₂ Fertilisation

No CO₂ Fertilisation

$m_3 \text{ ha}^{-1} \text{ yr}^{-1}$



Scenario A2
2080



Summary

- Process-based modelling effective platform in exploring impact of climate change
- Modelling suggests that CC will have net increase in *E. fastigata* productivity
- Environmental factors with the greatest impact:
 - CO₂ fertiliser effect
 - » A valid assumption?
 - Number of frost days



Summary

- Ongoing questions
 - CC predictions are climatic averages – how close to they represent actual climate?
 - Are 2°C rise scenarios obsolete?
 - How to simulate extreme events?
 - What is the impact of shallow soils on future productivity?
 - How to compare CC results with other land use models?



Acknowledgements

- Future Forests Research
- TRANZFOR
- Insitituto Superior de Agronomia

