

# The effect of Global warming and atmospheric CO<sub>2</sub> elevation on Carbon dynamics of Australian temperate forests (Mountain Ash)

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## Introduction

- Australia's forests are a critical natural resource that must be sustainably managed
- Australian native forests occupy 164 million ha, approximately 21% of the continent landmass, a potentially important carbon sink. However, there are few studies of carbon flux dynamics of native Australian forests
- Flux measurement network limited in Australia (OZFLUX) when compared to Europe (EUROFLUX) and North America (Ameri FLUX) etc.
- This study will determine the uptake/release of carbon from old growth and regrowth Mountain Ash forests
- This study will contribute to Australian policy development in carbon accounting through National Carbon Accounting System (NCAS), in abiding to international conventions
- This study is part of a project aiming to understand the current cycles of carbon, water and energy and how these may change over time hours to centuries. This study will integrate our observations with state-of-the-art models to improve our predictions of how forests will respond to change. This will aid our management of forests and forested catchments

## Study aims

To understand the "Carbon dynamics of the Mountain Ash forests" it is important to have an understanding of

1. The current carbon inventory
2. How climate change & change in atmospheric CO<sub>2</sub> will affect the forests into the future
3. How forest age will affect the change in Carbon dynamics

## Study objectives

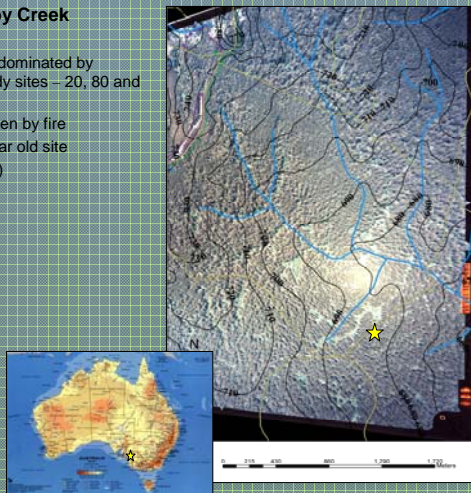
- Undertake biometric measurements for the old growth and regenerating forests.
- Construct a carbon inventory for the old growth forest
- Measure fluxes of CO<sub>2</sub> and energy for the old growth forest
- Investigate long-term impacts of climate change and atmospheric CO<sub>2</sub> elevation on the Mountain Ash forests
- Calibrate the Terrestrial Ecosystem Model (TEM) (McGuire et al.) and use the field data to run the model

## Study area – Wallaby Creek catchment

- Wallaby Creek Catchment dominated by Mountain Ash forest (3 study sites – 20, 80 and 300 year old)
- Matrix of different ages driven by fire
- A Flux Tower at the 300 year old site (A 110 m guide mast tower)



Flux tower at 300yr site



300 year old

Mean canopy height 80.4m  
LAI 3.36 (with understory)  
and Mean DBH 221.3cm



80 year old

Mean canopy height 60.1m  
LAI 2.09 and Mean DBH 97cm



20 year old

Mean canopy height 21.2m  
LAI 2.62 and Mean DBH 22.1cm

## Mountain Ash forests (*Eucalyptus regnans*)

- Tallest angiosperm, typically 50-90 m at maturity
- Tallest individual recorded, 114 m height
- High quality timber species, high productivity
- > 3 million ha in SE Australia
- Occurs in Victoria and Tasmania
- Cool, moist upland sites, 150 to 1100 m altitude, ~1000 mm annual rainfall
- Hot fire required for regeneration (trees killed)
- Fire initiates massive seed-rain event, 2.5 million seed ha<sup>-1</sup> shed
- Light-demanding seedlings v. high growth rate in resultant ash bed
- Even-aged stands regenerate following this disturbance



## Methods

A cross synthesis of different methods will be employed to study the carbon dynamics of the Mountain Ash forests. The methods employed are:

- Biometric measurements
- Eddy covariance measurements
- Terrestrial Ecosystem Model (TEM)

### Biometric data collection

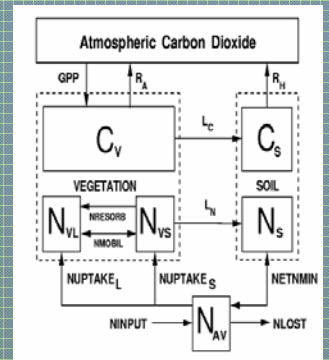
- Determine the current carbon budget of the old growth forest and gather data to calibrate and run TEM
- Data for Wood, leaf, roots and coarse woody debris biomass, soil respiration, soil carbon and soil nitrogen will be collected

### Eddy covariance measurements

- Directly measures the net CO<sub>2</sub> and water exchange between the atmosphere and the forest
- Instruments employed include: 3D sonic anemometer CSAT3, First response CO<sub>2</sub>/H<sub>2</sub>O open path infrared gas analyzer (LI 7500), and Data logger CR5000
- In addition to the EC measurements, canopy CO<sub>2</sub> profiles and standard meteorological parameters will also be measured

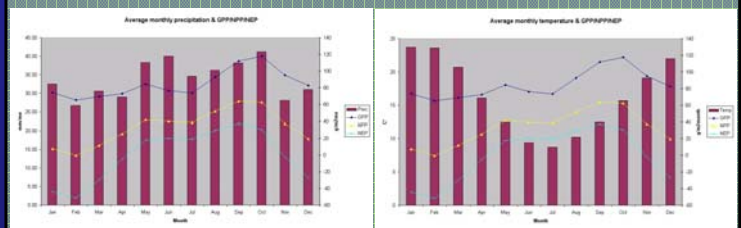
### Terrestrial Ecosystem Model (TEM)

- TEM is a process based global scale ecosystem simulation model that incorporates components of coupled carbon and nitrogen cycle and runs at a monthly time step.



Schematic representation of the TEM model showing Carbon and Nitrogen pools and fluxes

## Example of TEM simulation results



- Default parameters for Temperate coniferous forest (Taita New Zealand) and grid cell based climatic data for the Kinglake region from 1900 to 2000 have been used for the example simulation. This illustrates the typical carbon balance data that will be available for simulations proposed for the Mountain Ash forest.
- Future work will include the parameterisation of the TEM model using site specific data from filed measurements and literature.
- Anticipated results include the simulation of the effect of global warming and atmospheric CO<sub>2</sub> level elevation on carbon dynamics in to the future (100 years)

## Web sites

- Project web site [www.arts.monash.edu.au/ges/research/climate/Mountainash/index.html](http://www.arts.monash.edu.au/ges/research/climate/Mountainash/index.html)
- Ozflux - [www.clw.csiro.au/research/landscapes/interactions/ozflux/index.html](http://www.clw.csiro.au/research/landscapes/interactions/ozflux/index.html)

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