

World's tallest angiosperm acts as a carbon sink

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1. Introduction

A long standing ecological orthodoxy that relates to the decline in aboveground biomass accumulation with stand age has been a central basis for the assumption that old growth forests play a minor role in the carbon cycle (Fig 1). Recent findings across a broad range of climate regions have demonstrated that old growth ecosystems are not in a state of ecological equilibrium, but rather, act dynamically to changes in climate and stand structure. This study aims to quantify the exchange of carbon, energy and water above and below the canopy of an Australian old growth temperate forest.

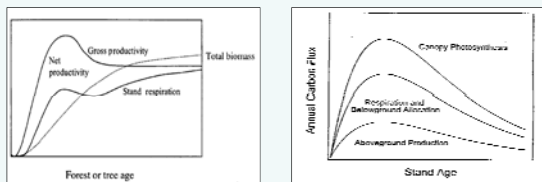


Figure 1. Traditional conceptual diagrams that explain the decline in productivity with stand age

2. Study site and method

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
- Moist upland sites~1000mm annual rainfall



- A 110 metre tall tower with Eddy Covariance and meteorological instrumentation.
- Measurements above and below the canopy
- Nighttime corrected and gapfilled data
- Neural network derived Re and GPP



Plate: Sillett & Antonie (2006)

- Ancillary data (stem increment, litter, CWD, chamber flux data etc) were also collected.

3. Results

The annual carbon sink strength into the ecosystem was estimated to be 375 (325 – 425) g.C.m⁻² in 2006 (Fig 2), whilst NPP was estimated to range between 740 – 980 g.C.m⁻².y⁻¹. Carbon fluxes were highly seasonal: sink/source showed low variability during winter. High variability was observed in summer due to a combination of environmental constraints that included VPD, soil moisture and PAR (Fig 3).

Using EC and chamber flux data, we separated the component carbon and water fluxes between the overstorey and understorey species for a 5 month period (Dec 2005 – April 2006). Analysis revealed that the understorey contribution to ecosystem NEE and GPP was typically between 20 – 40% during the daytime

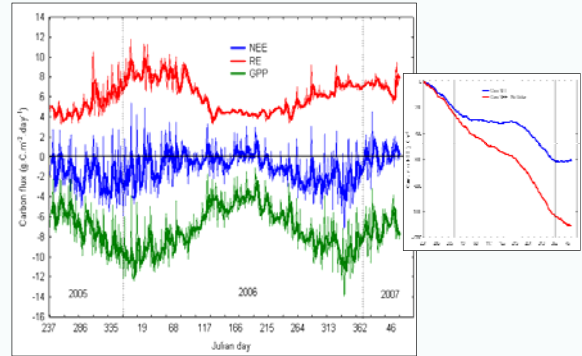


Fig 2. Daily NEP, GPP and Re (dashed lines), with 10 day moving averages (solid lines) for the 18 month study period. The inset figure shows cumulative NEP using corrected and uncorrected nighttime fluxes

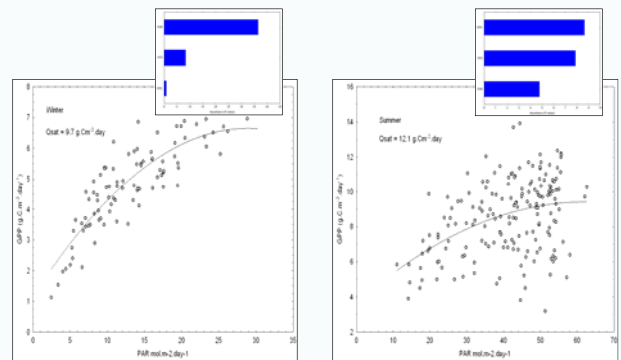


Fig 3. Light use response curves fitted with the Michaelis-Menten function for winter and summer. The degree of importance of climate variables are plotted in the insets

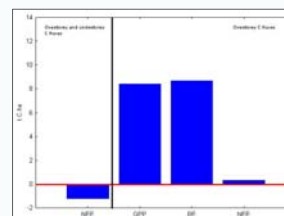


Fig 4. Carbon balance of ecosystem with and without understorey vegetation C flux components. Data period was between Dec 2005 and Apr 2006.

4. Discussion

Our results support recent studies in the literature that have demonstrated carbon accumulation in old growth forests, which contradicts previous conceptual models. Furthermore, vital understorey flux data enabled us to determine that the sink strength of the ecosystem was due to the uneven stand structure of the ecosystem (Fig 4). The carbon sink status of old growth natural forests may be underestimated in current global carbon models due to successional shifts in species composition. Old growth forests may present a valuable carbon store, and consistent carbon sink in the future if effectively managed.

Acknowledgements

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