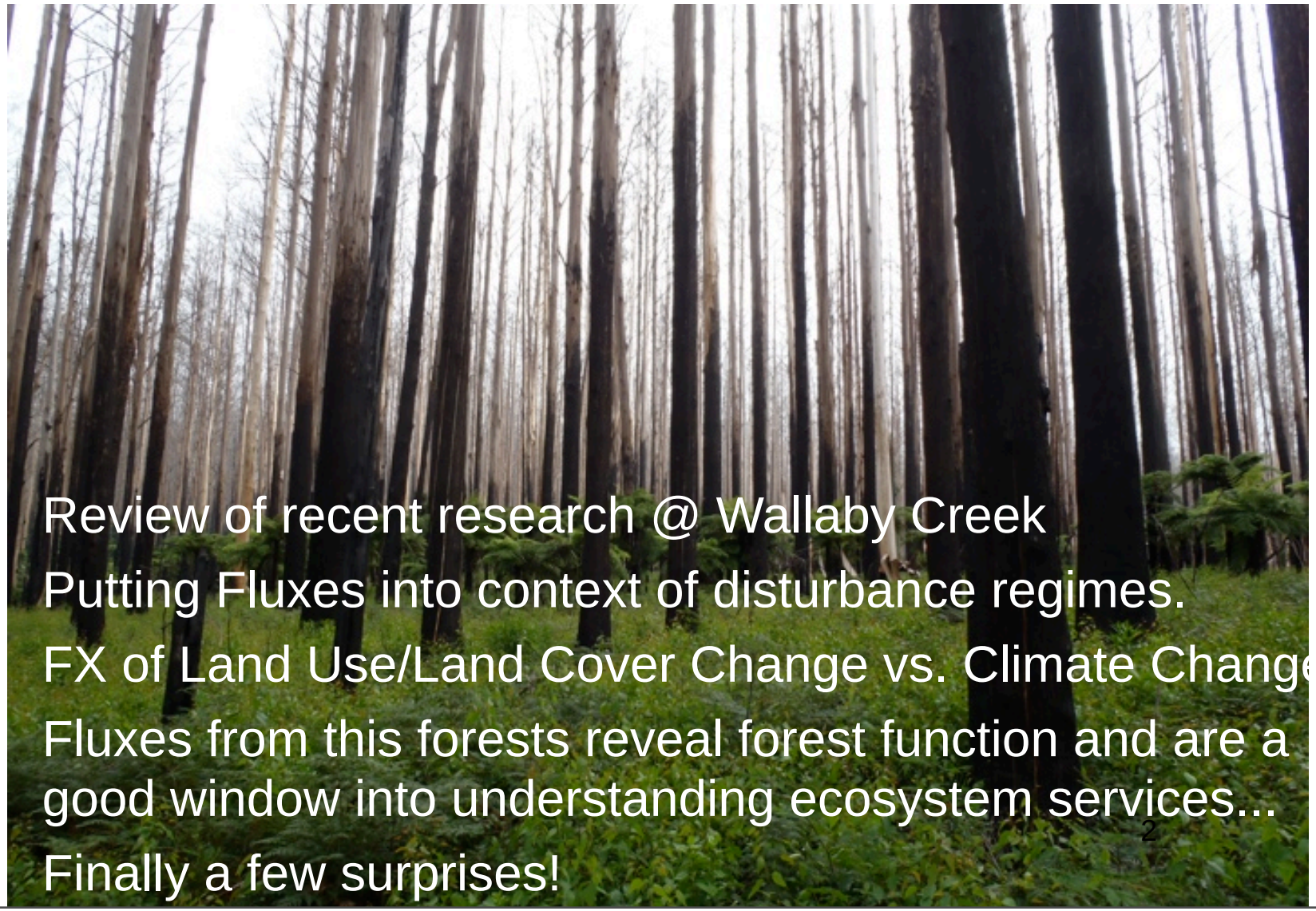
MONASH University

Mountain Ash: World's tallest angiosperm, World's most carbon dense forest, OzFlux tallest Tower?

Wallaby Creek



Review of recent research @ Wallaby Creek

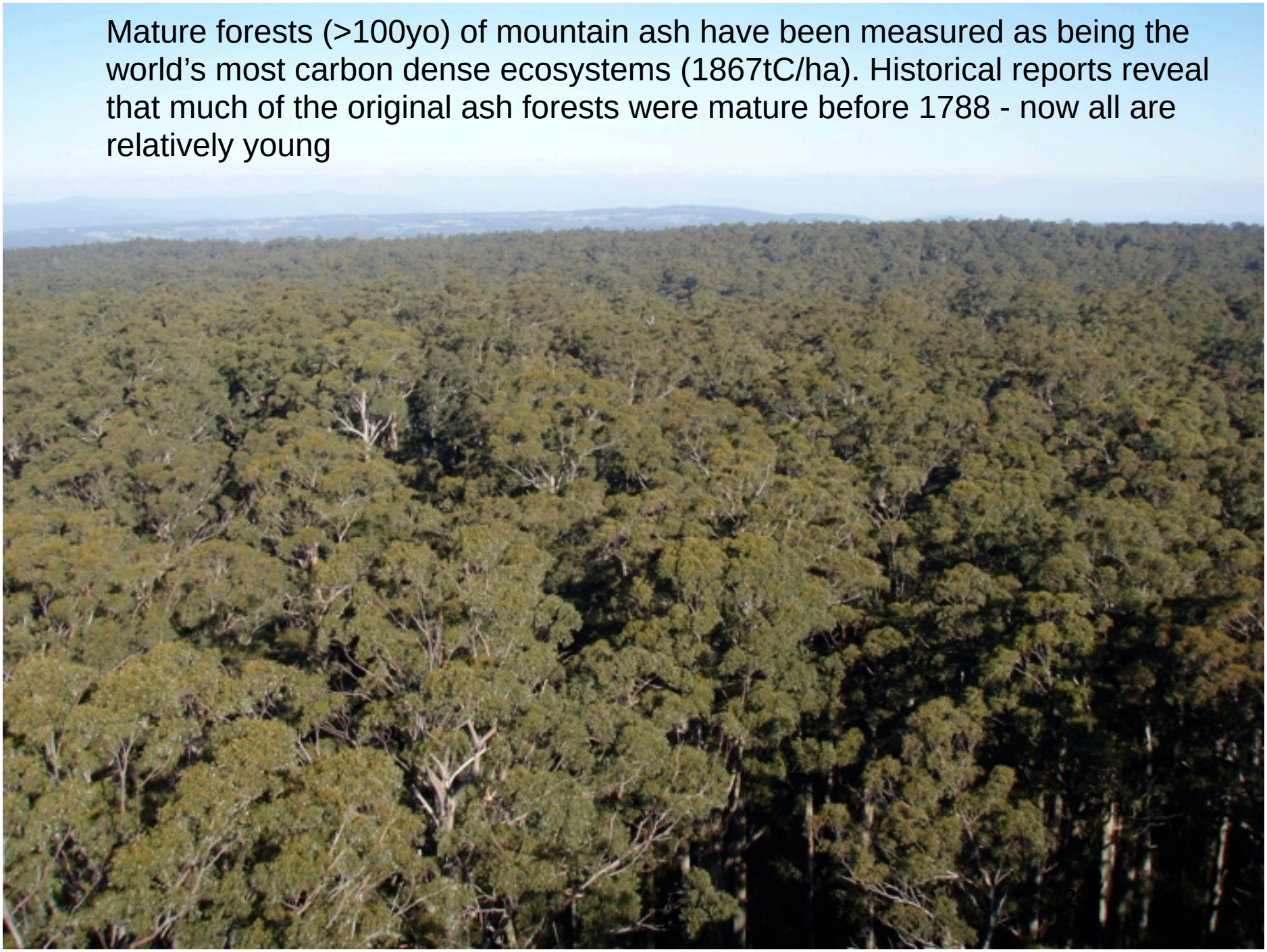
Putting Fluxes into context of disturbance regimes.

FX of Land Use/Land Cover Change vs. Climate Change

Fluxes from this forests reveal forest function and are a good window into understanding ecosystem services...

Finally a few surprises!

Mature forests (>100yo) of mountain ash have been measured as being the world's most carbon dense ecosystems (1867tC/ha). Historical reports reveal that much of the original ash forests were mature before 1788 - now all are relatively young



1824
1857
1895
1905
1908
1926
1932
1939
1948
1983
2003
2009

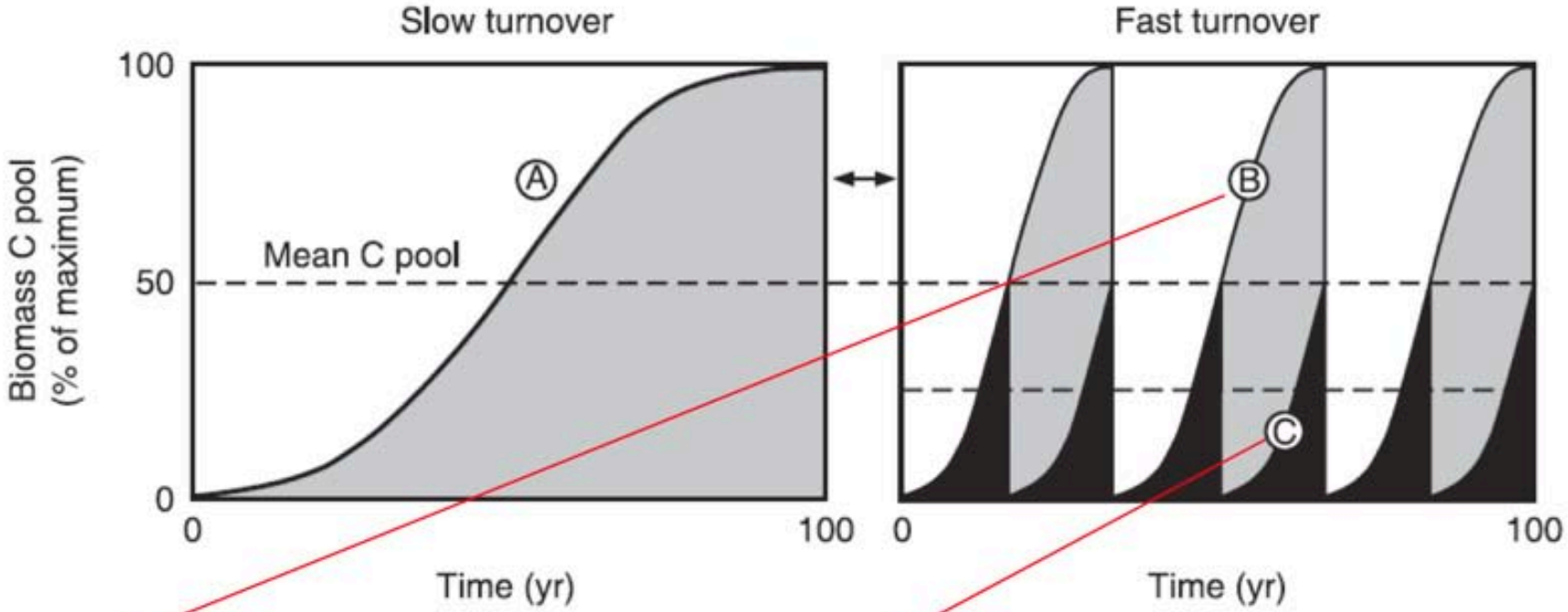

“The many combinations of disturbance agents (and their severity, homogeneity, extent and frequency) combine with underlying differences in terrain and climate to generate distinctive stand development trajectories”
David Lindenmayer

Just after the fire George Koch and co. came over from the US and climbed the dead stags, to do a range of work including destructive harvesting, and estimated standing dead biomass.

Established allometric equations estimated 1288 t/ha of standing dead biomass:

Over-storey log biomass, (kg)= 1.8595 x log (dbh) +0.241
Under-storey log biomass (kg) = 2.8878 x log (dbh) - 1.5001
(unpublished data, first pass processed, not QC). Leaf biomass was estimated but likely to contribute to regrowth NEE as it decomposes.

We can estimate the before and after fire carbon balance, and measure the fluxes for old-growth and regrowth, and can estimate emissions from the slow decay of standing dead biomass. Long term estimates for carbon pools could measure maximums or may be better explained using the mean carbon pool.

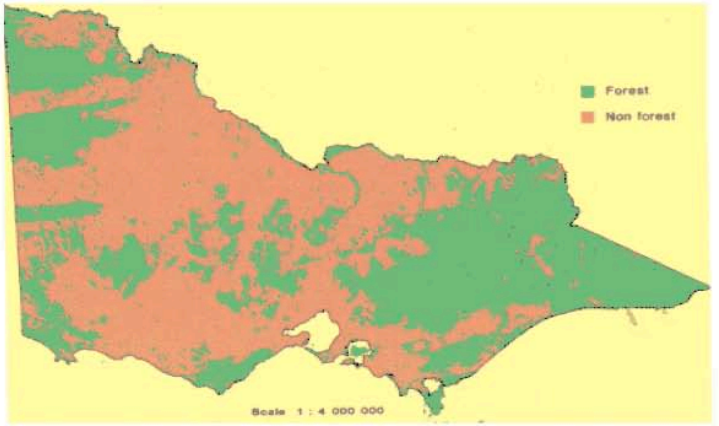


B) Growth rate is tripled compared to A, but biomass C pool over time remains the same

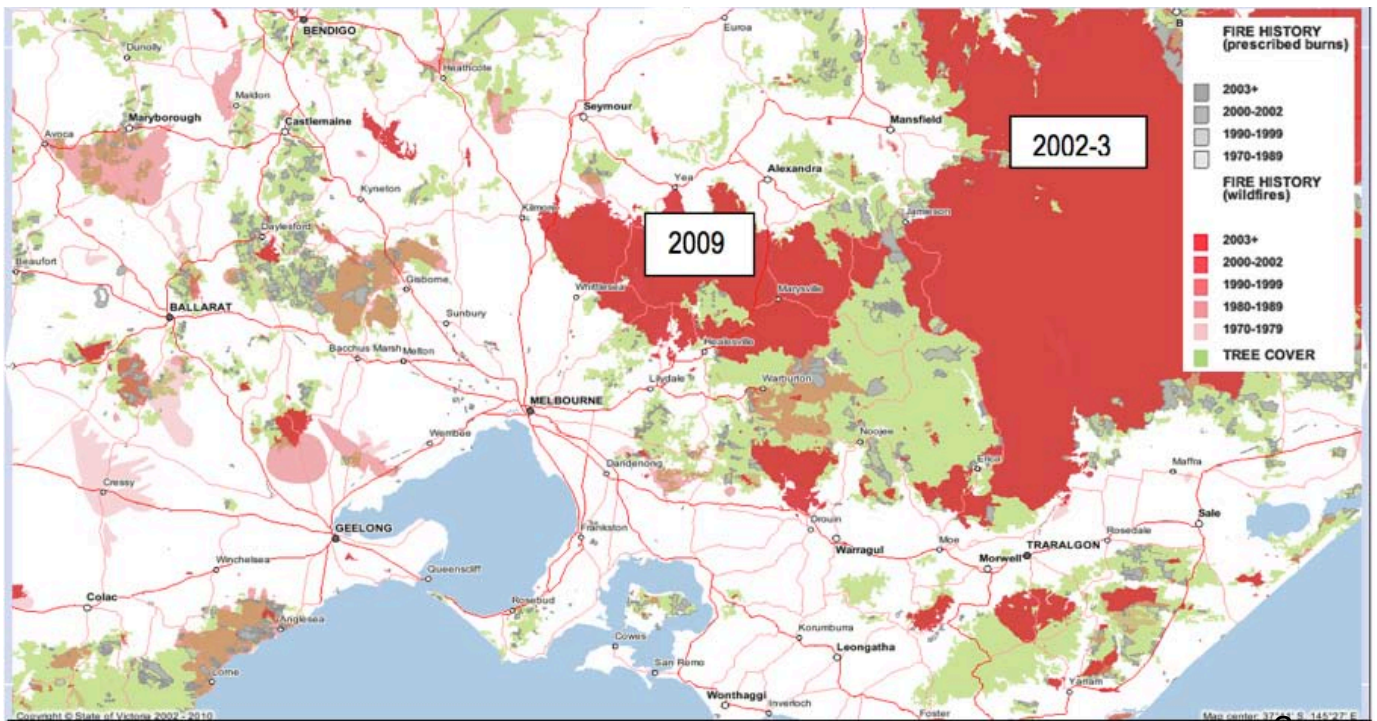
C) Short rotations: harvested in most productive stage, increase in yield but biomass pool size is diminished!

B & C = high cash flow (growth rate)
A = high capital (biomass carbon store)

Körner, New Phyt (2006) 172: 393–411

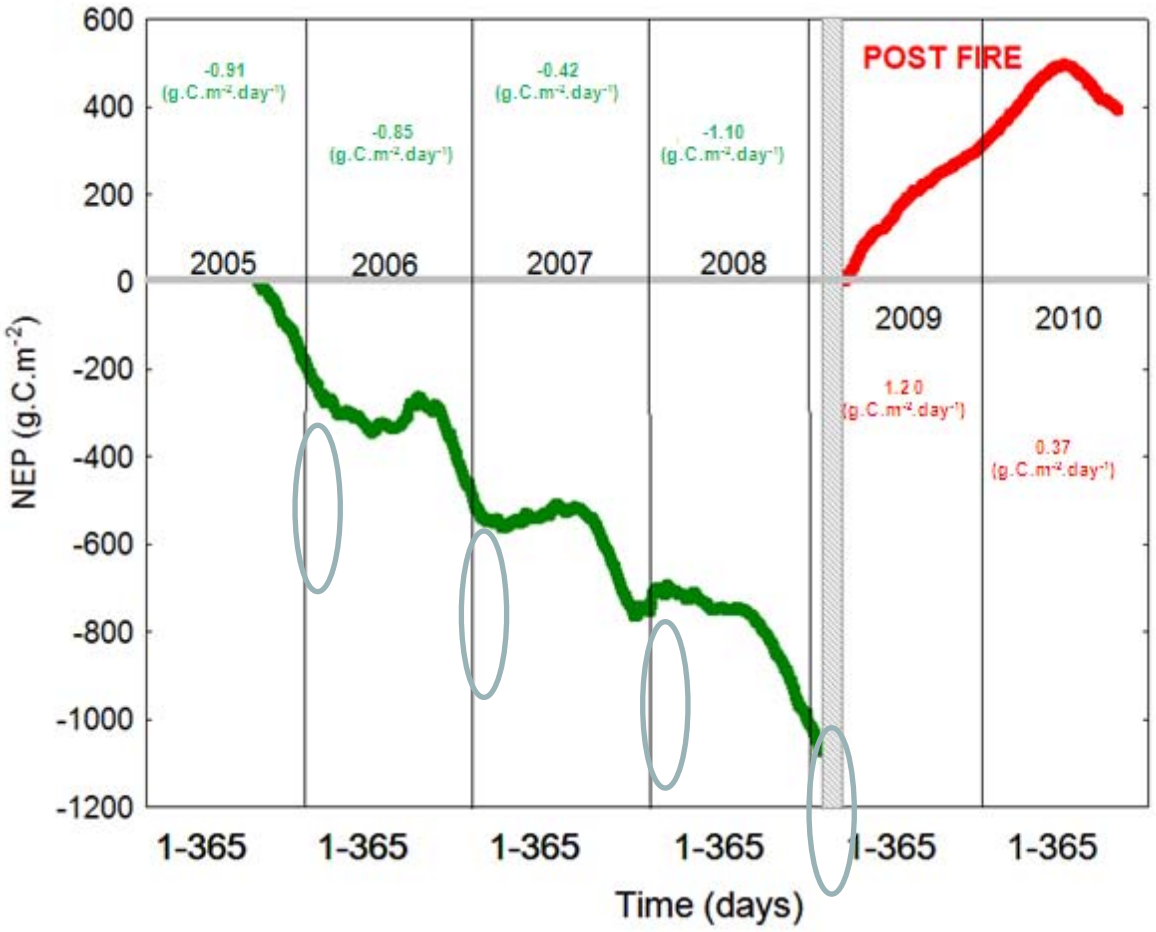


Land Cover Change: Victorian forest cover 1869 to 1987, 12 million Ha converted from forest into agricultural lands – a 65% loss of forest (woody veg.>2m, foliar cover>10%). (www.environment.gov.au/biodiversity/publications/series/paper6/biovic.html).



Melbourne region: a recent history of prescribed burns and wildfires
source: DSE, http://nremap-sc.nre.vic.gov.au/MapShare.v2/imf.jsp?site=forestexplorer

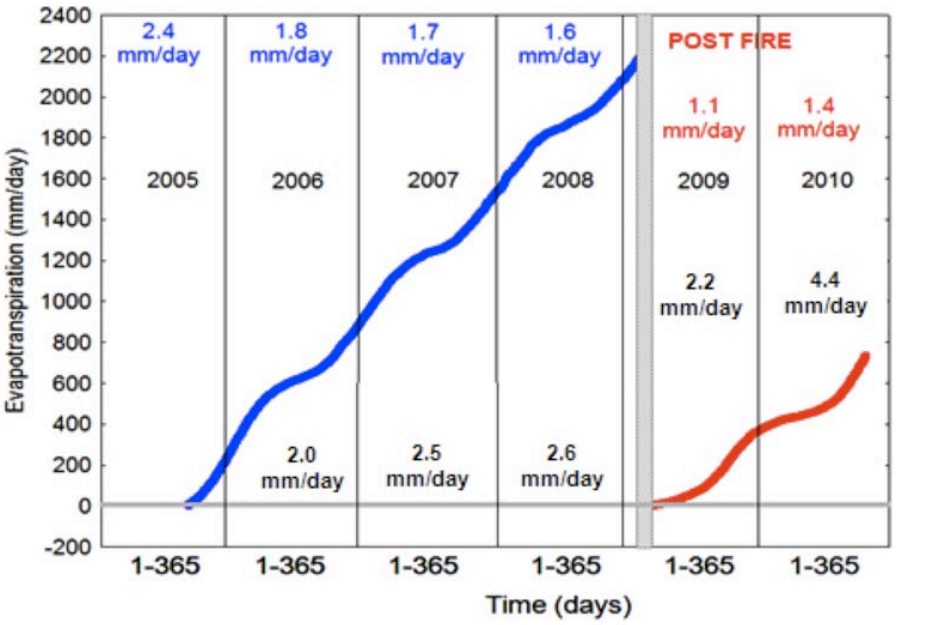
Net ecosystem productivity (pre and post fire)

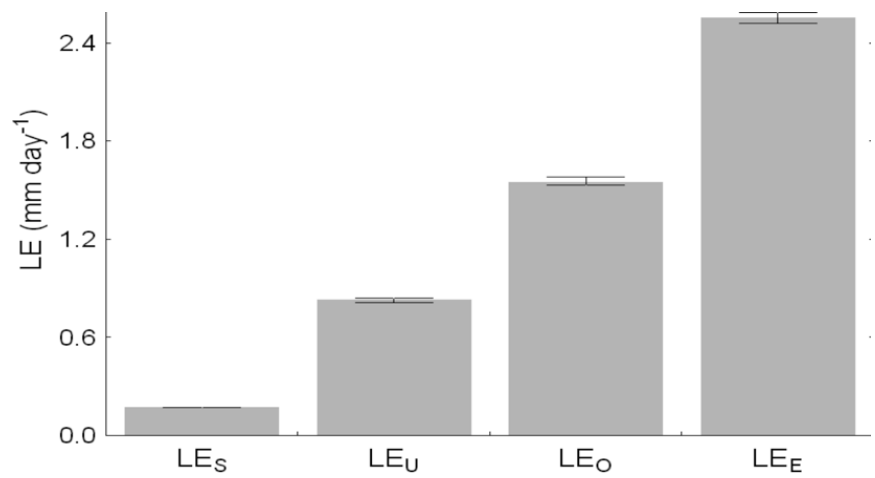


- Continuous and consistent carbon sink between 2005 and 2009.
- Maximum carbon uptake occurs during spring.
- 2007 an exception – In December the site had nearly twice the average rainfall and cloud cover compared to the long term average.
- Strong source of carbon after the fires, but rapid recovery – 2011 may have been a sink?

Musa Kilinc, Jason Beringer, Lindsay Hutley, Vanessa Haverd, Nigel Tapper (2012) An analysis of the surface energy budget above the world's tallest angiosperm forest (Agricultural and Forest Meteorology; in press)

Evapotranspiration (pre and post fire)





Evapotranspiration again was relatively constant between years.

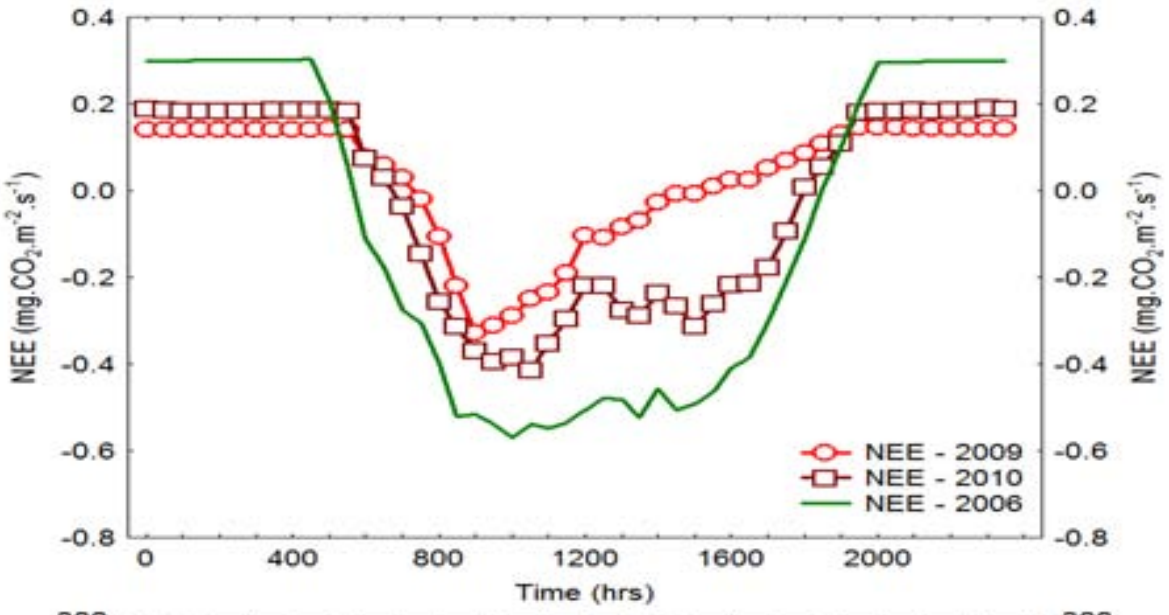
Maximum ET occurring through spring and summer

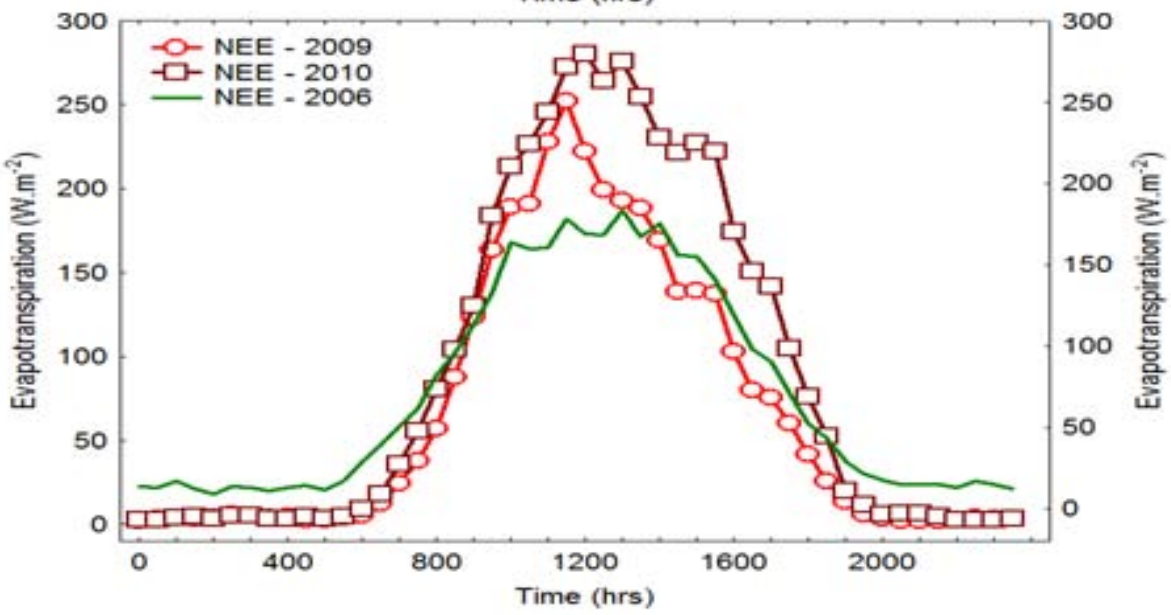
ET rapidly increasing after the fires.

In 2005 – the understorey, ecosystem and surface fluxes were measured.

Findings suggest that forest structure is important in the partitioning of energy and carbon.

Diurnal NEE and ET (pre and post fire - December)

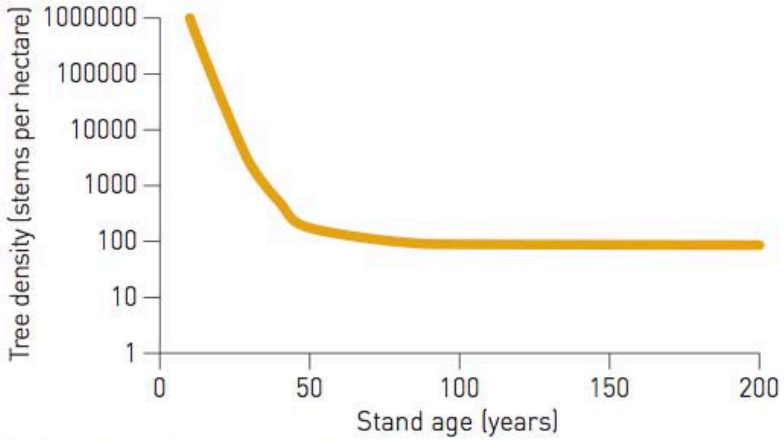




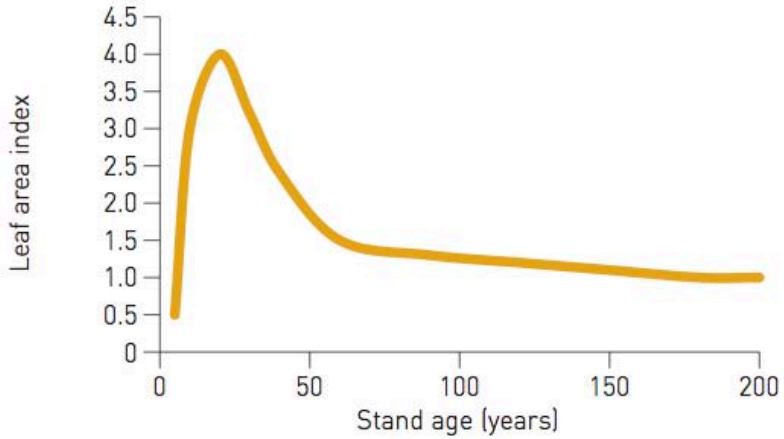
- Large variations in the diurnal uptake/release of carbon and water – major changes in the peak time of assimilation.

- Both NEE and ET after the fires suggest peak ecosystem activity in the morning. One year after, the ecosystem activity occurring over a longer range.

- Evidence for nocturnal drivers of for ecosystem water use pre and post fire.



C. Relationship between stand age and tree density for Mountain Ash forest north of Melbourne. Redrawn from Ashton 1976, cited in Vertessy et al. 1998.



D. Relationship between stand age and LAI for Mountain Ash forest north of Melbourne. Redrawn from Ashton 1976, cited in Vertessy et al. 1998.

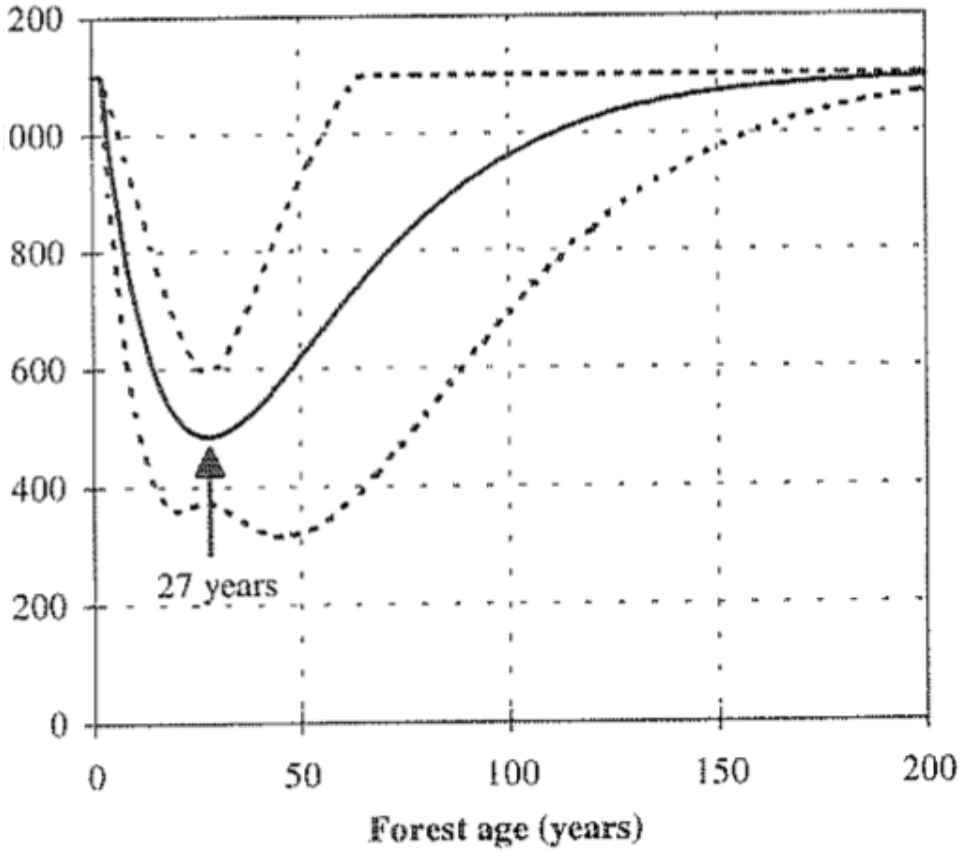
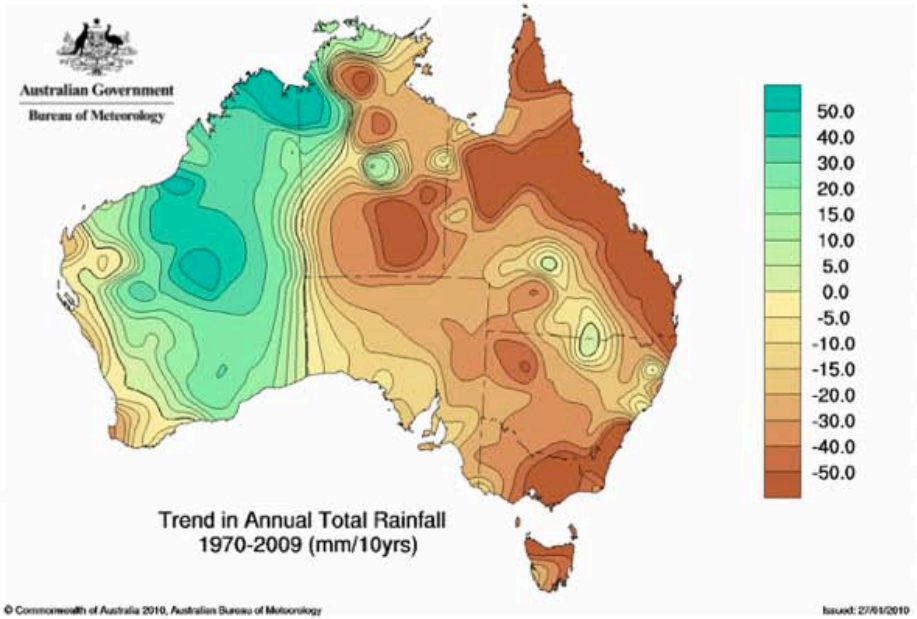
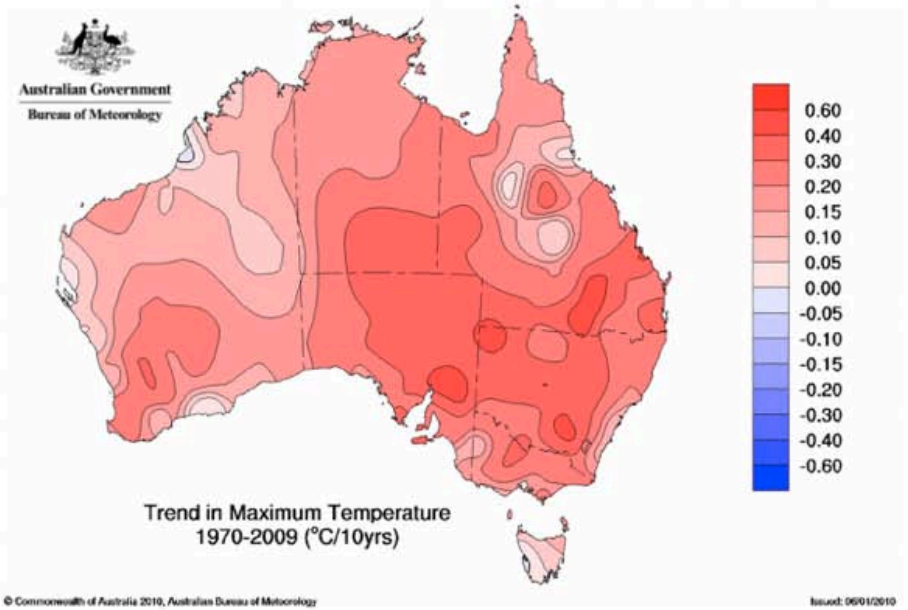


Figure 1: The Kuczera curve (with 90% confidence its) predicting water yield decline from forest age in Mountain Ash forests.

Watson & Vertessy 1997

These two slides simple versions used in a talk by Stefan Arndt





Measured trends in total annual rainfall and maximum temperature in the last 40years. SE Australia has experienced drying and warming, and these trends are predicted to increase further – with associated increased fire risk (source http://www.bom.gov.au/cgi-bin/climate/change/trendmaps)

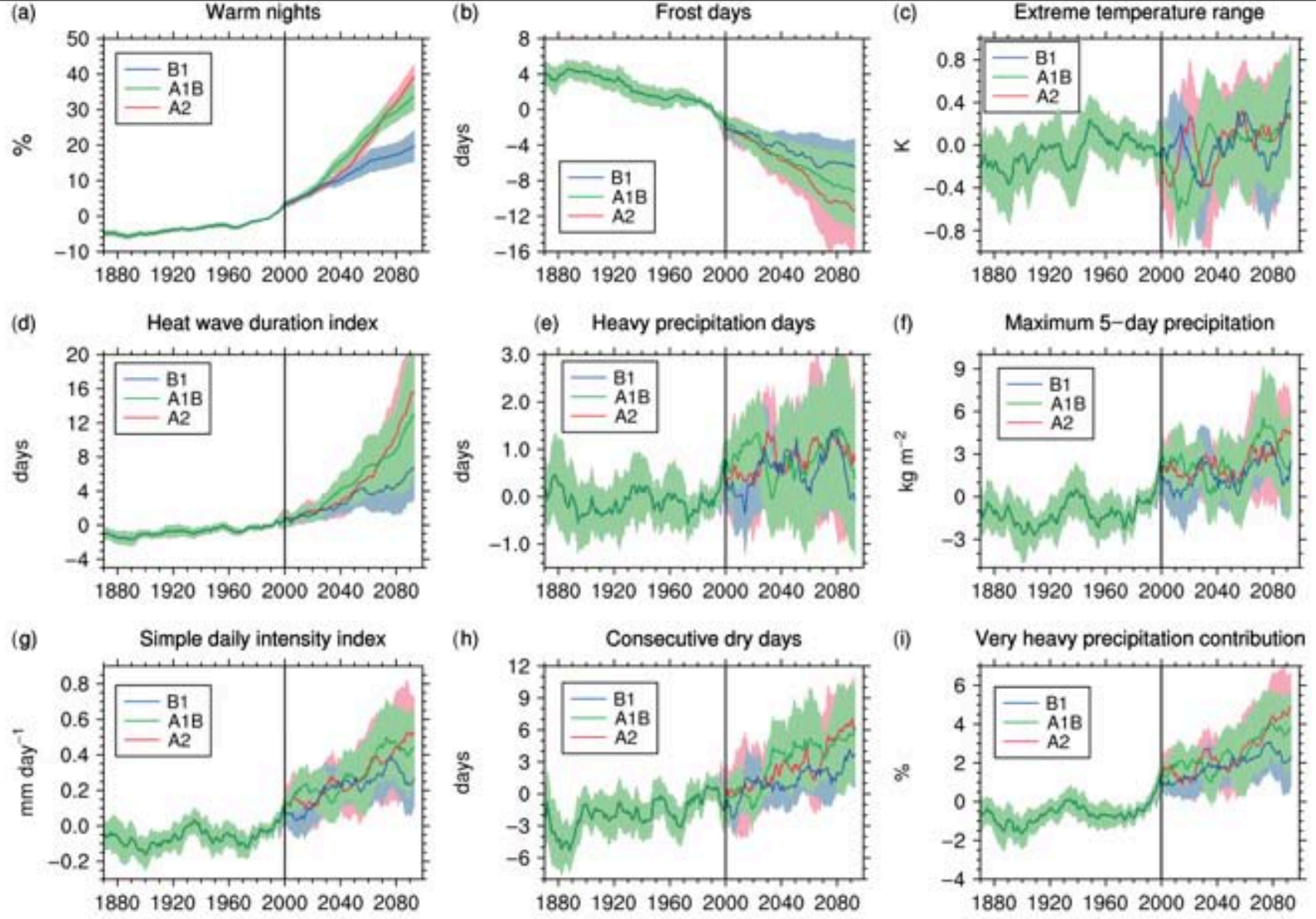
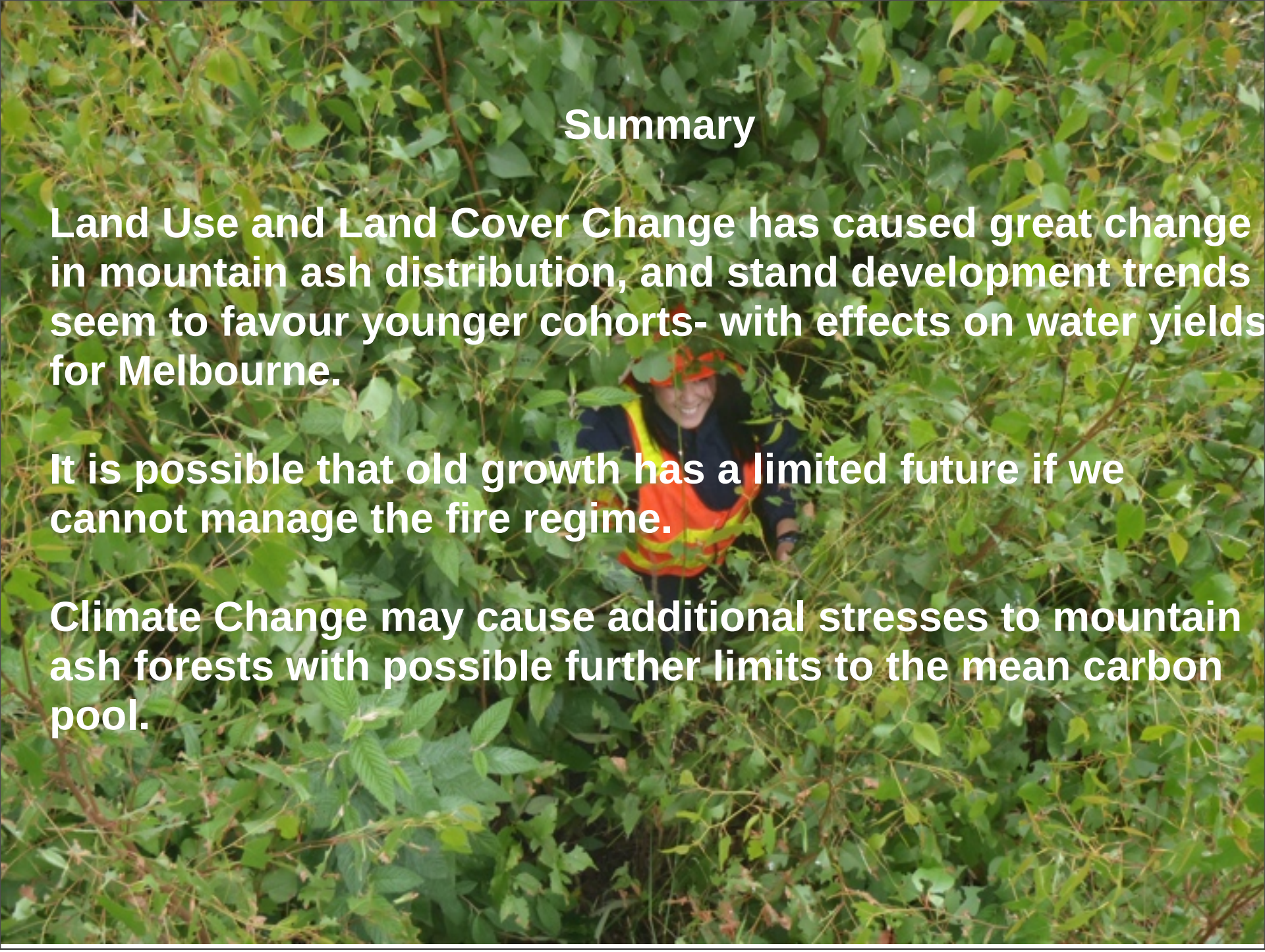


Figure 9. Time series of areally averaged extremes indices (Frich *et al.*, 2002) between 1870 and 2099 using grid boxes in Australia with the observed data from Figure 2 (temperature) and Figure 3 (precipitation). The multi-model ensemble mean (solid lines) of nine models from the CMIP3 dataset is shown for the SRES B1, A1B and A2 scenarios, with shading representing two times intermodel standard deviation. All model time series are smoothed with a ten-year running mean. This figure is available in colour online at www.interscience.wiley.com/ijoc

from Alexander et al 2009

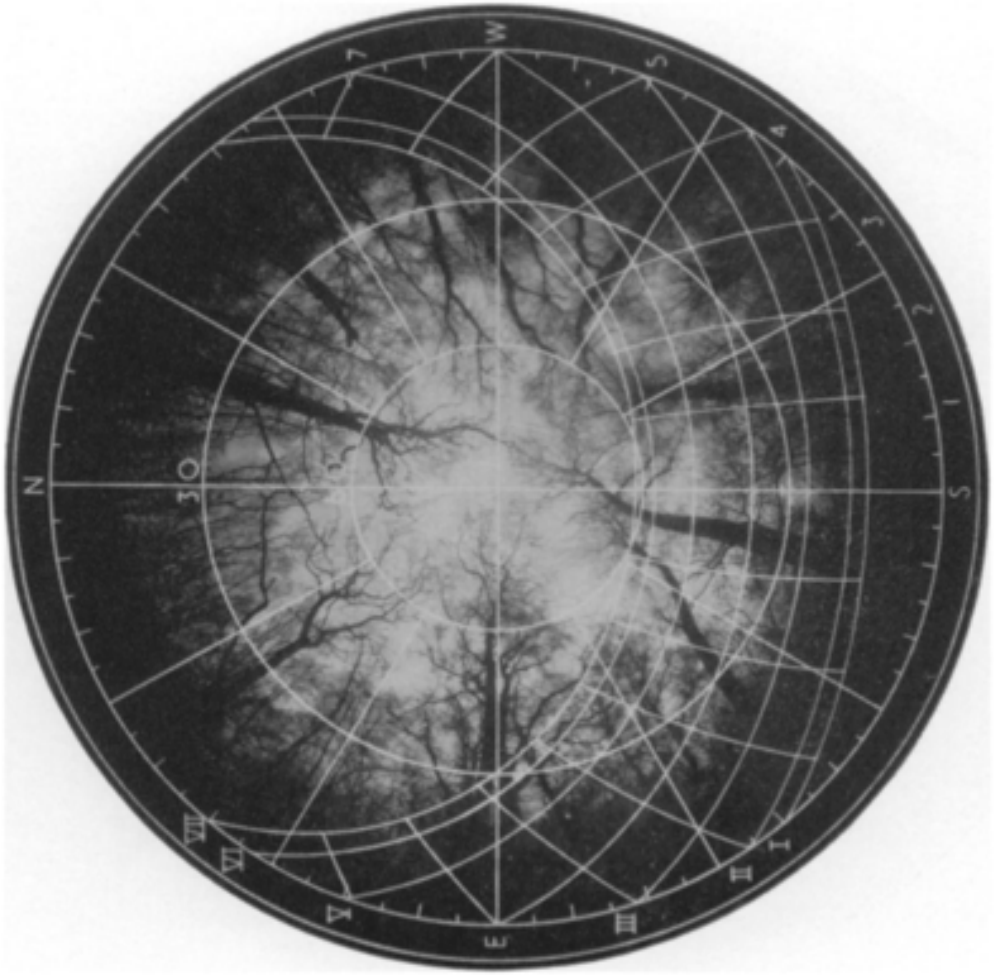


Summary

Land Use and Land Cover Change has caused great change in mountain ash distribution, and stand development trends seem to favour younger cohorts- with effects on water yields for Melbourne.

It is possible that old growth has a limited future if we cannot manage the fire regime.

Climate Change may cause additional stresses to mountain ash forests with possible further limits to the mean carbon pool.



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Saturday, 14 July 2012