SYNTHESIS

Optimisation of fuel reduction burning regimes for carbon, water and vegetation

An interdisciplinary approach to examine **trade-offs** between **environmental objectives** and **prescribed burning**

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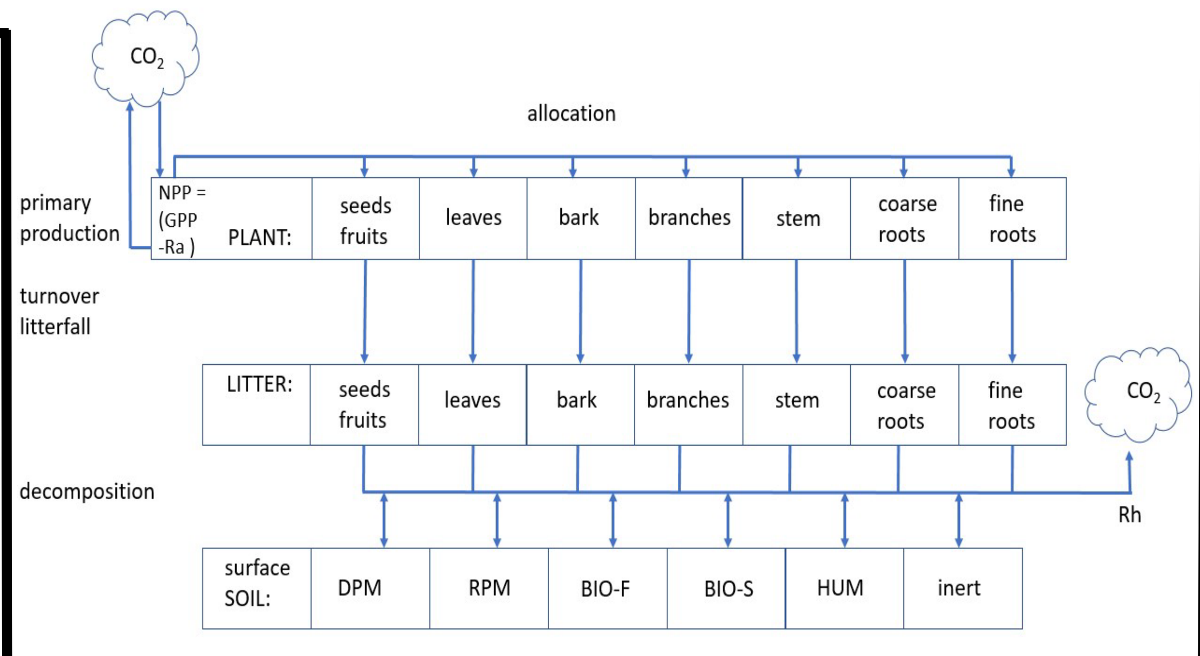
Model predictions for prescribed burning in the greater Blue Mountains

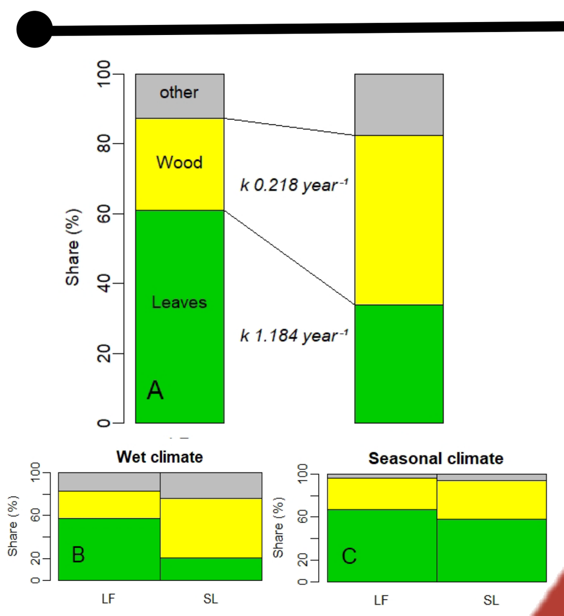
- The FullCAM carbon accounting model was applied to eucalypt open forest sites in the Blue Mountains region that underwent prescribed burning and fieldwork.
- Calibrations to fractions of surface litter would improve simulations of the effect of prescribed fire on forest component pools.
- Recommendations on collecting field data and model structure are made to improve alignment between them.



Carbon stocks and flows incorporated in the FullCAM model applied to forest ecosystems by deploying the forest system option.

Litterfall and standing litter in forests: implications for fuel loads

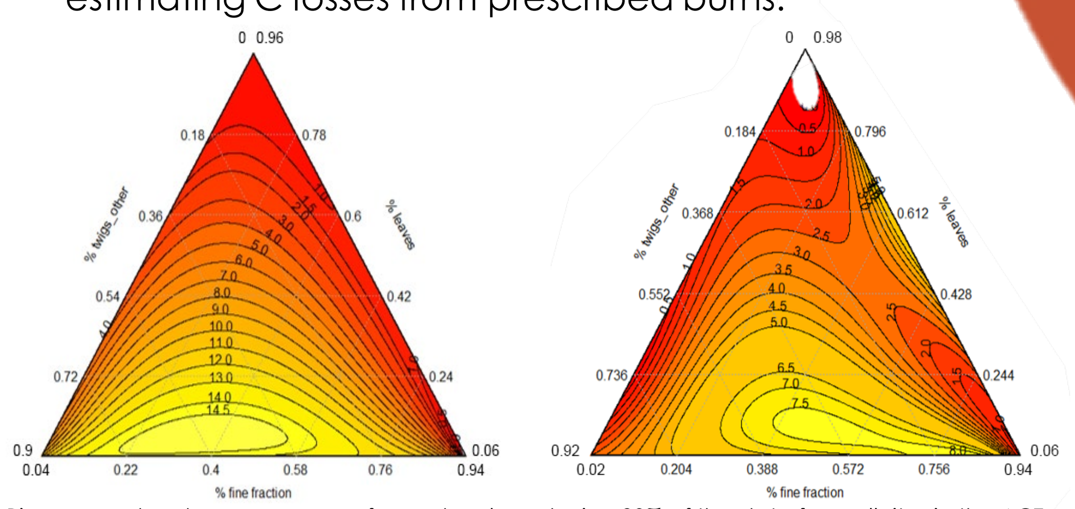
- Data for standing litter (SL) and litterfall (LF), including both fine (leaves) and woody fuels (twigs, bark <20-26 mm) were compiled for forests in Australia.
- The average mass of SL is 11 t ha^{-1} and ~5 t ha^{-1} of leaf and woody litter is added annually.
- Olsen's decomposition constant (k) varied substantially with different fractions of fine and woody fuels.



Proportional differences of LF and SF (A) in forests in Australia, and (B) among states with a wet climate (VIC, NSW, ACT, TAS) compared to (C) those with a more pronounced seasonal climate (WA, SA, NT).

Estimating carbon stocks and biomass in surface fuel layers

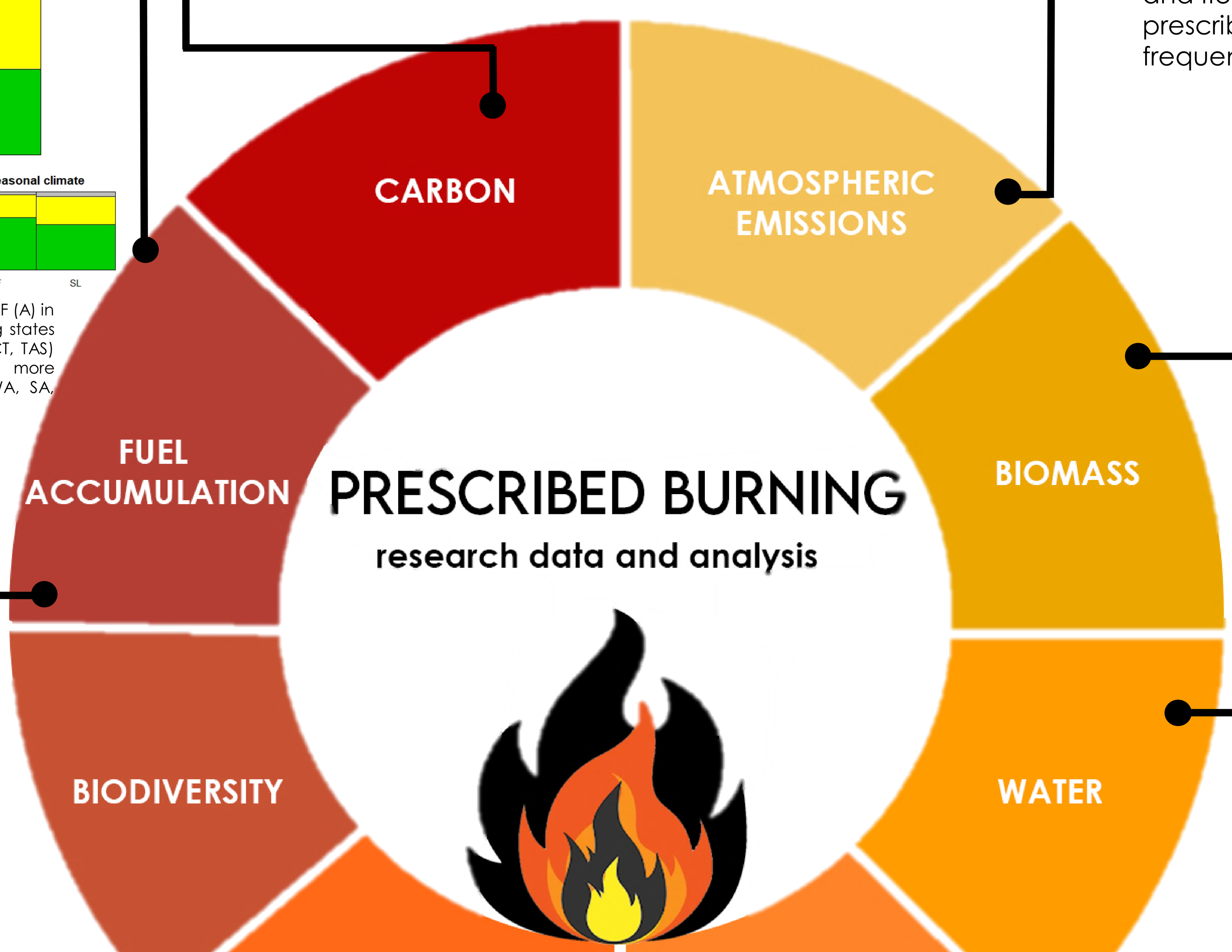
- Empirical data was used to generate prediction tools for estimating C and biomass in surface fuel layers.
- Models estimated a biomass range of 1 to 14.5 t ha^{-1} and a carbon content range of 0 to 8 t ha^{-1}.
- Ability to model C content of individual fractions in surface fuel layers is important and can assist in increasing accuracy in estimating C losses from prescribed burns.

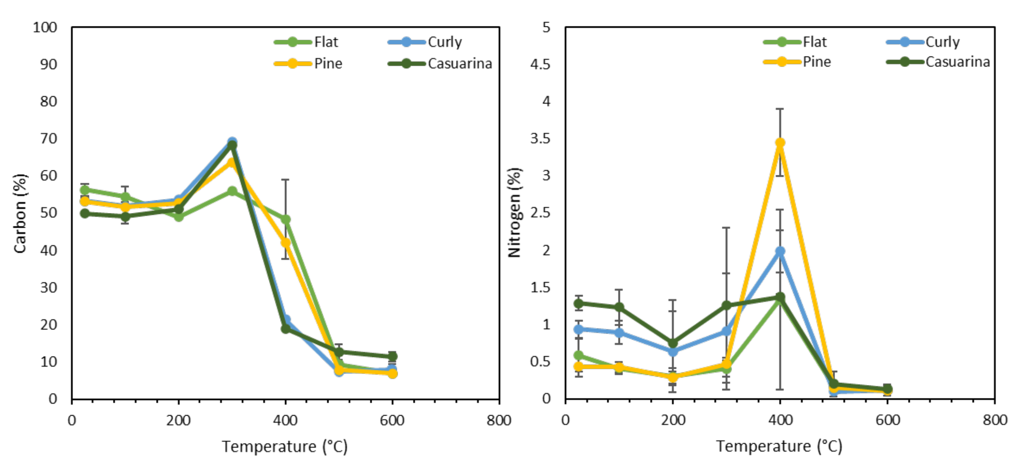


Biomass and carbon response surfaces developed using 80% of the data from all sites in the ACT, NSW and VIC, before and after prescribed burning.

Quantifying the conversion of vegetation to ash

- Combustion studies can be used to determine fire intensity and residence time from the type and amount of charred material, charcoal and ash produced.
- Greater amounts of carbon were lost when fuels were heated at 300 °C or more.
- Small amounts of biomass, carbon and nitrogen was lost when heated ≤ 200 °C, regardless of the fuel burnt.
- Nitrogen was more abundant when heated at 400 °C, though at low levels (< 5%).





Carbon and nitrogen (%) at each temperature for leaves. Points represent mean ± standard deviation.

Modelling emissions from prescribed burning using FullCAM

- FullCAM was assessed in simulating CO_2 emissions from prescribed burns under different fuel load scenarios plus wildfire.
- Total carbon emissions depended on the fuel loads (size of the pools e.g. leaf litter) and the pool-specific rate of combustion.
- Calibration of FullCAM should be possible, accommodating considerable site variation.
- FullCAM provides a solid framework for understanding and tracking stocks and flows of carbon exposed to prescribed burns at different frequencies.

Estimated amount of carbon (C) emitted (mean ± standard deviation) for sites in NSW.

Site name	Carbon emitted (t C ha^{-1})
Joadja	6.81 ± 1.20
Martins Creek	5.74 ± 2.51
Left Arm	4.41 ± 0.43
Spring Gully	3.31 ± 0.08
Helicopter Spur	2.93 ± 0.89
Kief Trig	2.82 ± 0.58
Lakesland	2.50 ± 0.33
Paterson	2.48 ± 0.43
Haycock Trig	2.05 ± 0.47

Prescribed burning and sampling at 100 sites

- Burn units from locations in Victoria, NSW and the ACT were surveyed.
- Burn units are paired sites measured before and after fire or in adjacent unburnt and burnt areas.
- Total sampling effort in this project has amassed to 100+ burn units.

Modelling evapotranspiration (ET) using generalised additive models (GAMs)

- GAMs for predicting evapotranspiration (ET) developed for Victoria and NSW, using site details, soil properties, climate and enhanced vegetation index (EVI) as variables.
- Changes in ET due to prescribed burns were more obvious in Victoria than NSW.
- EVI and climatic variables were the best predictors for changes in ET due to prescribed burning.

Effective predictors (orange shading) of GAMS developed for predicting ET: prescribed fire (fire) solar radiation, discount factor value at 5 and 95% confidence intervals (df5 and df95), maximum temperature (T_{max}) and minimum temperature (T_{min}).

State	Fire	Solar radiation (MJ m^2)	EVI	df5 (mm)	df95 (mm)	T_{max} (°C)	T_{min} (°C)
NSW							
Victoria							
Combined							

Near infrared spectroscopy (NIR) as a fire severity metric

- Surface fuels from forests and woodlands were combusted under controlled conditions in the laboratory.
- Residue colours were more uniform when described using NIR spectroscopy compared to the visual Munsell Colour System.
- NIR spectroscopy reduces inaccuracies with conventional subjective colour scoring.
- NIR spectroscopy data can be used in regression models to predict C and N content in residues, and the temperatures they were formed at.

Comparisons of Munesll colour, ash residue and L*a*b colour of turpentine bark from the trial material burnt at temperatures between 100 and 600 °C.

Australian Government
Department of Industry, Science, Energy and Resources
Business Cooperative Research Centres Program

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