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OPTIMISATION OF FUEL REDUCTION BURNING REGIMES FOR FUEL REDUCTION, CARBON, WATER AND VEGETATION OUTCOMES

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Project synopsis
The key objective of this research project is to develop a spatially explicit model of the effects of fuel reduction burning regimes, including fires of different size, on fuel loads, vegetation composition, carbon balance and hydrological cycles, both individually and in aggregate (i.e. at the catchment- or landscape-scale). The model will be designed to be used in conjunction with planning of fire regimes by land management agencies in forested catchments across landscapes in southern Australia.

Introduction
Application of fuel reduction burning (FRB) to eucalypt forests has been guided for many years by knowledge of the fire-response traits of key plant and animal species. Managers have been able to prioritise FRB in a spatial context on this basis. Similarly, landscape features are now moderately well understood in relation to FRB – some landscape positions and aspects are more manageable and amenable to burning than others, and, again, managers have been able to prioritise FRB on this basis. What has been lacking, but which has become increasingly important, is knowledge and projecting capacity of the effects of FRB on fuel loads of broad vegetation types and carbon and water potential (e.g. capacity for carbon sequestration, water yield) of the forests at a manageable spatial scale. This knowledge is required in a format that is readily useable by managers. Most commonly, this lies in the form of predictive models or tools. This project will move research and management capabilities to its next logical focus – building a framework and predictive model for planning of FRB.

The project
Two underlying issues need immediate research attention:

1. Limited knowledge of the water storage capacity and dynamics of soil profiles (e.g. to a depth of at least 1 m) – this hinders both our ability to model water fluxes, especially the yield of water to streams and dams, and our ability to model whole stand and forest water use, before and after fires.

2. Limited knowledge of the effects of differing fire intensities on soil carbon. This requires, *a priori*, development of techniques to reliably and routinely assess the fire-related temperatures within soils at different depths.

These key issues can be tackled within an overall framework of developing models to facilitate optimised FRB regimes. Such spatially explicit models will take account changes in fuel loads and predict the likely effects of individual fuel reduction fires and collectively as FRB regimes on vegetation load and composition and carbon and water potentials.

What has been happening?
The main activity for the first 6 months of this project has been to recruit staff to undertake research. We are in the process of recruiting two Postdoctoral Fellows and a Forester/Research Assistant. When we have the right people in place we will have a strong team that can collect (our Forester/Research Assistant), manage (our Postdoctoral Fellow – Data Management/Field Coordination) and interpret (our Postdoctoral Fellow – Spatial Modelling Biogeochemistry and

Fire) empirical data from the field. These new additions to the project team will be nurtured and supported by the current team member including Dr Tina Bell (Project Leader), Dr Tarryn Turnbull, Dr Malcolm Possell, Dr Tom Buckley and Prof Mark Adams. They will have access to modern laboratory and office space in the Centre for Carbon, Water and Food. This includes use of contemporary analytical equipment for all the techniques required in this project, including sophisticated mass spectrometry, calorimetry, photosynthesis systems and plant and soil chemical analysis.

We have recently taken delivery of a pyrolysis unit that is compatible with our existing gas chromatography-mass spectrometer. The purpose of the pyrolysis unit is to break up large macromolecules into smaller volatile products that can be separated and detected. This decomposition or fractionation will give us information about the structure and properties of the pyrolysed material. In the context of this project, such information is crucial in understanding how FRB affects soil carbon. This information will be used in conjunction with measurements of soil temperature and indices of fire intensity and severity.

An important activity has been regular interaction with our Lead End User, Belinda Kenny of NSW Office of Environment and Heritage.

We have developed the Project Management Plan, discussed potential student projects, begun to plan timing and location of field work and provided access to data from fire and land management agencies.

A literature review of modelling frameworks for landscape-scale sampling is being planned and contributing authors from Canada and the United States will be invited to join.

Publication list

Two relevant manuscripts have recently been submitted for publication:

Possell M, Jenkins ME, Bell TL, Adams MA (2014) Emissions from prescribed fire in temperate forest in south-east Australia: implications for carbon accounting. *Biogeochemistry* (submitted April 2014).

Jenkins ME, Bell TL, Norris J, Adams MA (2014) Pyrogenic carbon: the influence of particle size and chemical composition on soil carbon release. *International Journal of Wildland Fire* (accepted for publication June 2014).