Greenhouse gas emissions from fire and their environmental effects

Fire in the Landscape (Carbon)

FACULTY OF AGRICULTURE
& ENVIRONMENT

Malcolm Possell | Teaching and Research Fellow

THE UNIVERSITY OF SYDNEY

bushfire CRC

Background and aims

- Knowledge is lacking on:
  - direct effects of fuel reduction fires
  - or their secondary effects on ecosystem carbon balances.
- Models of gas emissions require accurate inputs
- BUT: we have very little empirical data to model carbon losses during fire.
- This project aims to improve our understanding of the relationships among fuel type and condition on emissions of greenhouse gases.

Research Projects

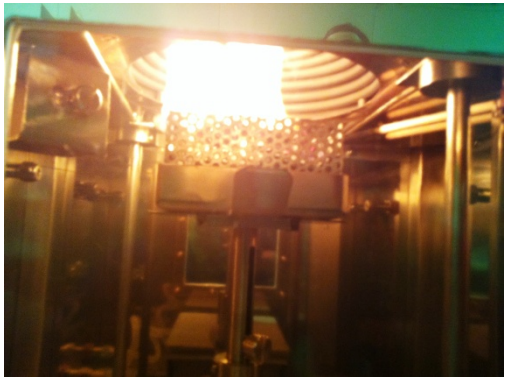
- Core Experiments:
  - Experiment 1: Effect of fuel moisture content on greenhouse gas emissions. Status: complete (paper published)
  - Experiment 2: Effect of moisture availability on flammability and emissions. Status: complete (draft manuscript)
  - Experiment 3: Field validation of moisture availability on flammability. Status: in progress (data analysis)
- Ancillary Experiments:
  - Experiment 4: A comparative study of smoke composition and flammability between sub-tropical and temperate grasses. Status: complete (AFAC conference paper)
  - Experiment 5: Effect of land management practices on flammability and gas emissions. Status: planned for New Year

Smoke composition and flammability measurements

IRGAs:
CO_2 and CO concentrations

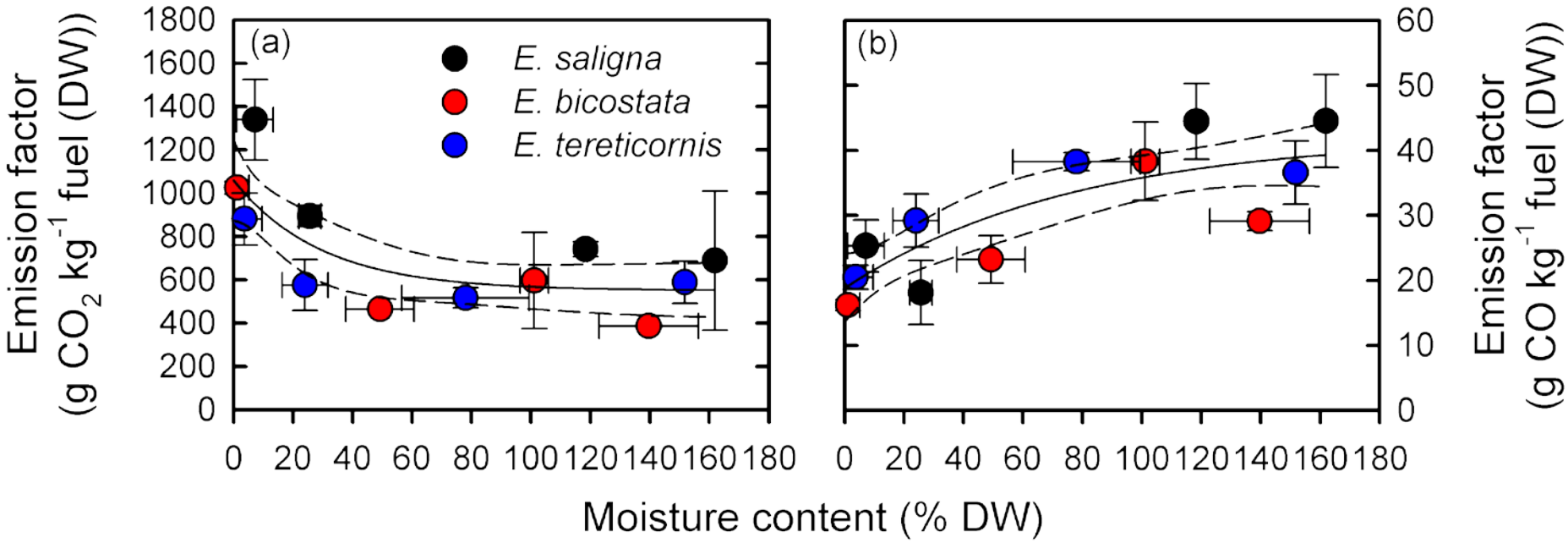
PTR-MS:
VOC measurements

Mass-loss calorimeter:
Energy release and mass loss under a fixed irradiance



Photos: F. Aires

Experiment 1: Effect of fuel moisture content on greenhouse gas emissions



Figures: Possell and Bell (2012)

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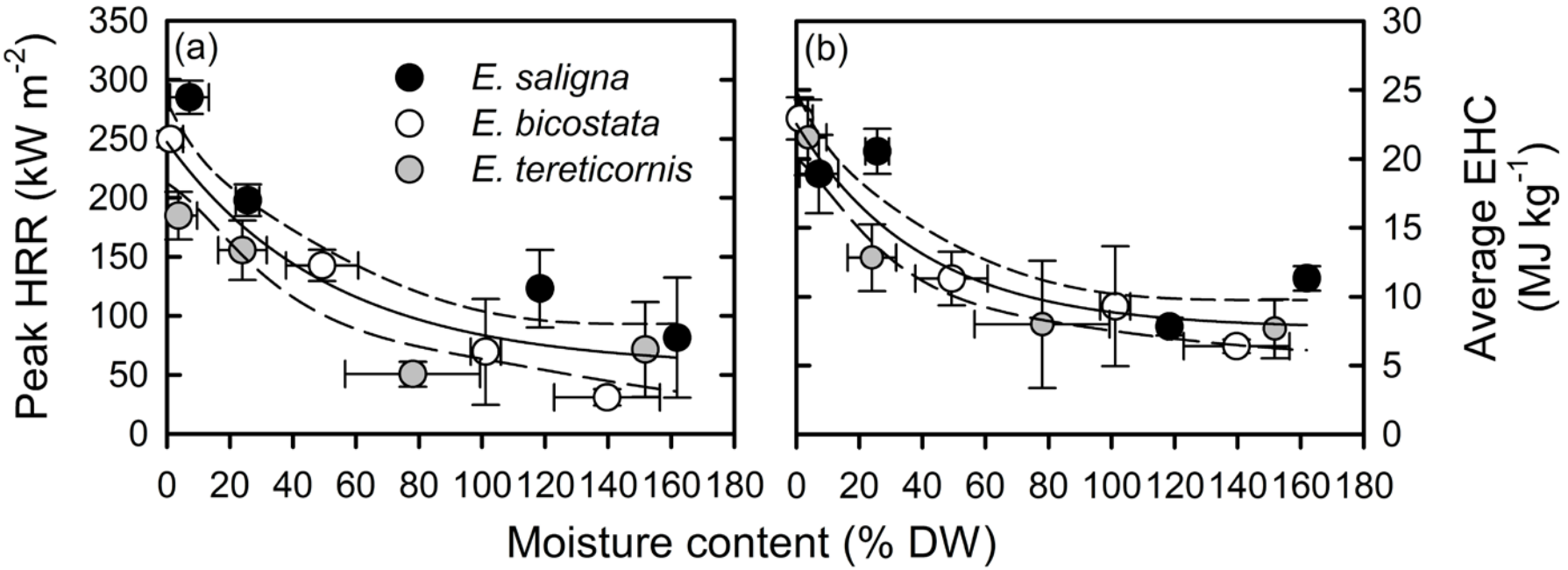


Figures: Possell and Bell (2012)

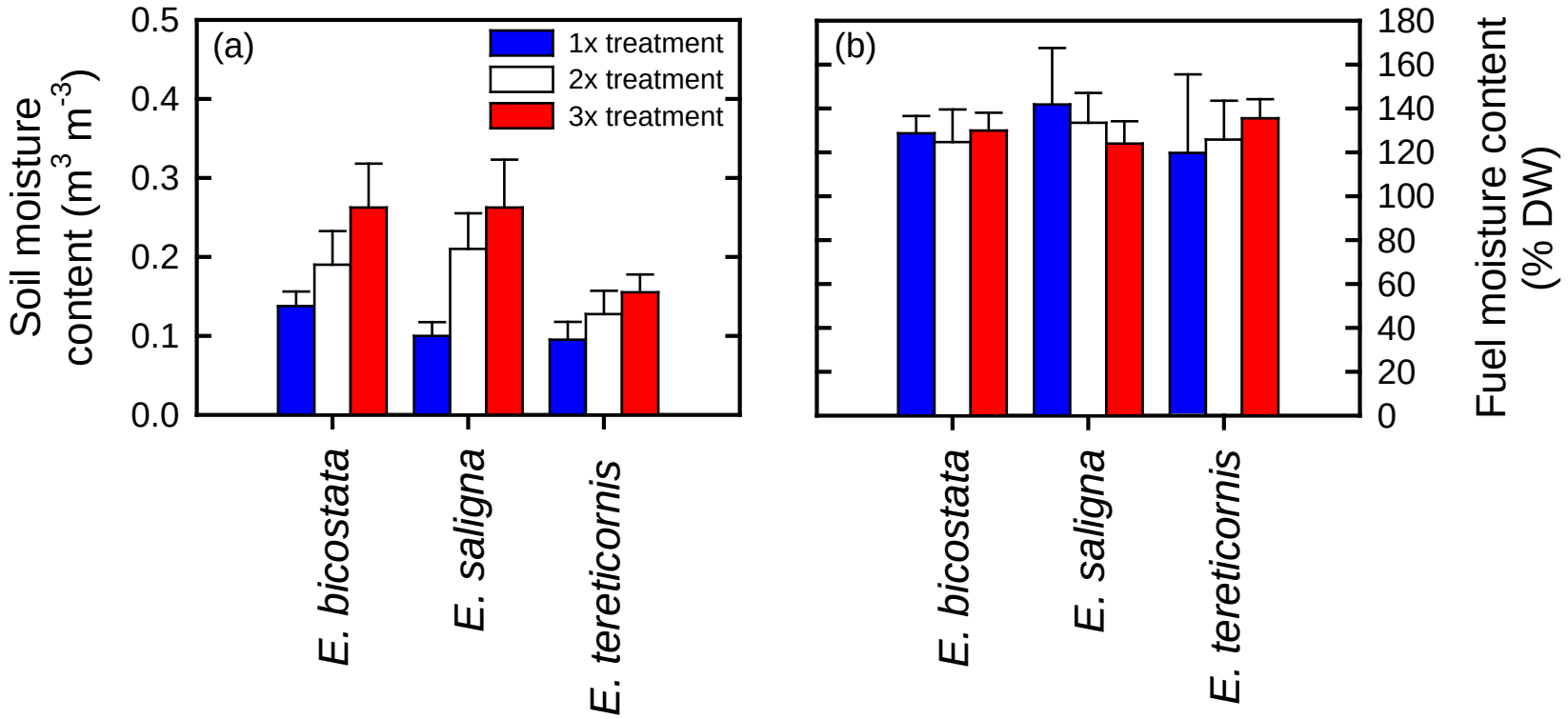
Experiment 2: Effect of fuel moisture content on greenhouse gas emissions

Aim: examine the effect of water availability on leaf moisture content and any consequent effect on energy release and combustion products

- 3 *Eucalyptus* species
- 3 watering regimes
- Soil moisture content measured regularly
- Leaf material collected after 12 weeks – analysed fresh or oven dried

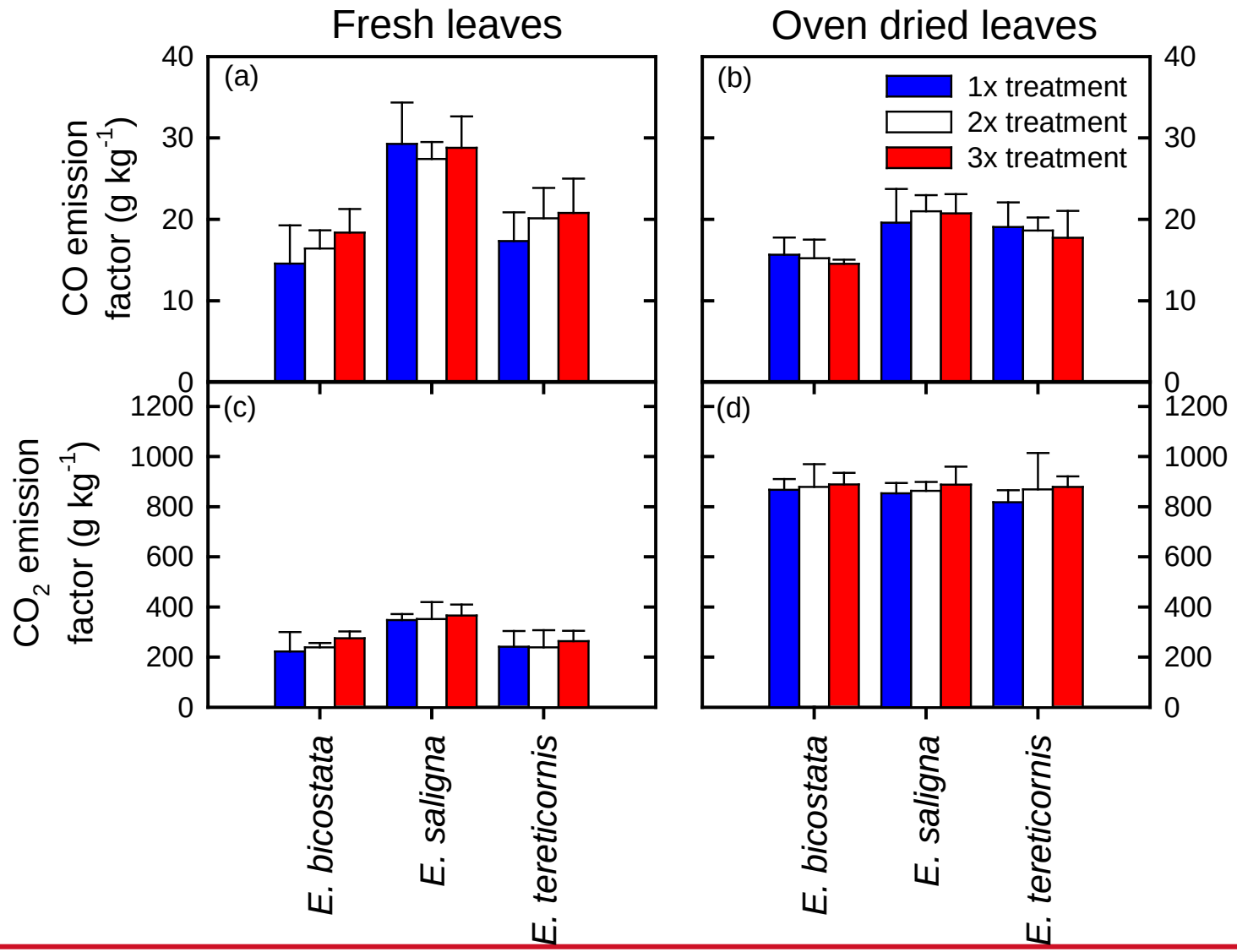
Photo: M. Possell

Experiment 2: Effect of fuel moisture content on greenhouse gas emissions



Figures: Possell and Bell (unpublished)

Experiment 2: Effect of fuel moisture content on greenhouse gas emissions



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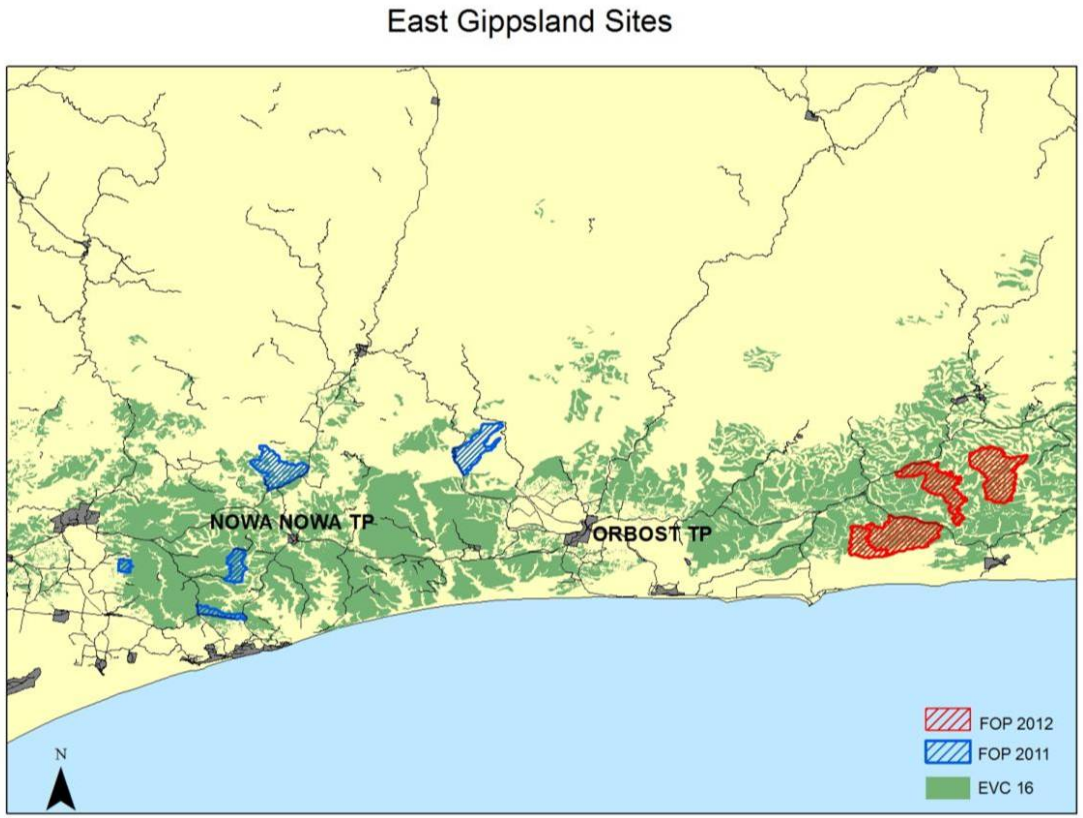
Experiment 3: Field validation of moisture availability on flammability

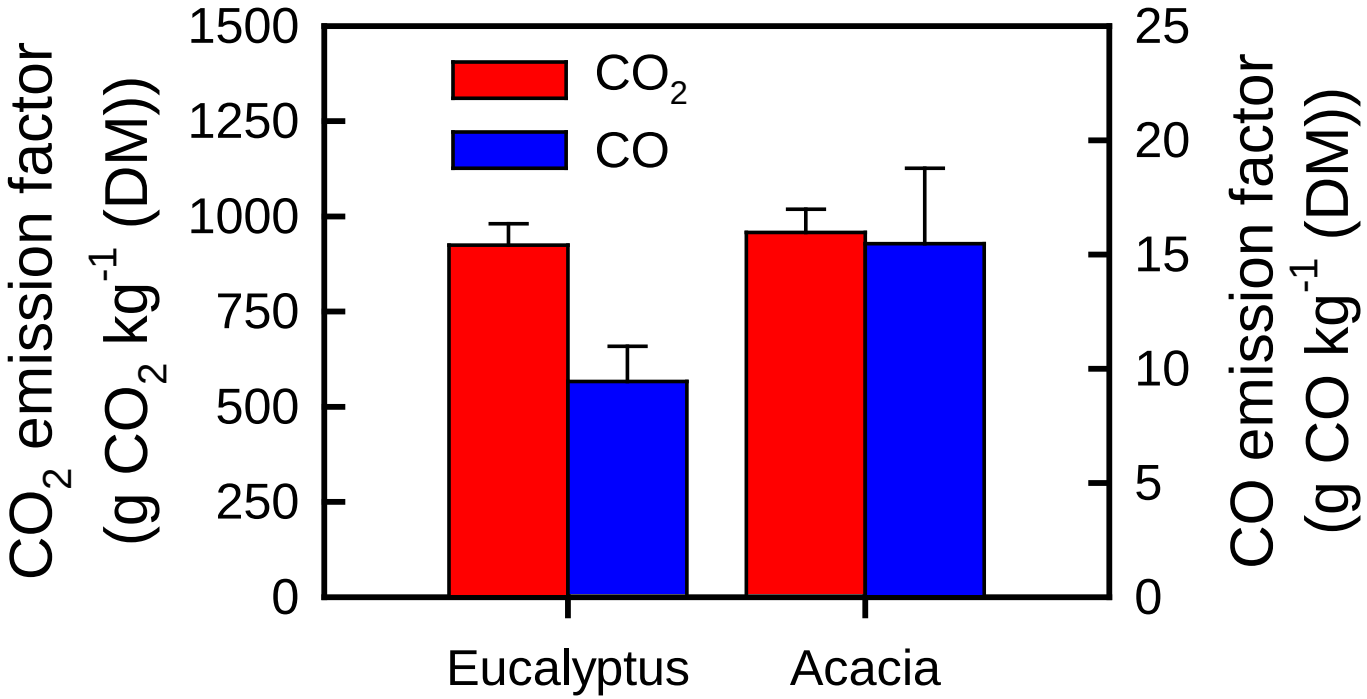
- Utilises material collected as part of an ARC Linkage Grant with DSE.
- The material analysed was collected from 4 sites near Orbost, VIC.
- Overstory dominated by eucalypts.
- Understory in the west is acacia and bracken. Grasses dominate in east.
- 5 fuel fractions analysed:
  - Overstory, understory, litter, duff, twigs.



Map courtesy of DSE

Experiment 3: Field validation of moisture availability on flammability

Overstory:



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Experiment 3: Field validation of moisture availability on flammability

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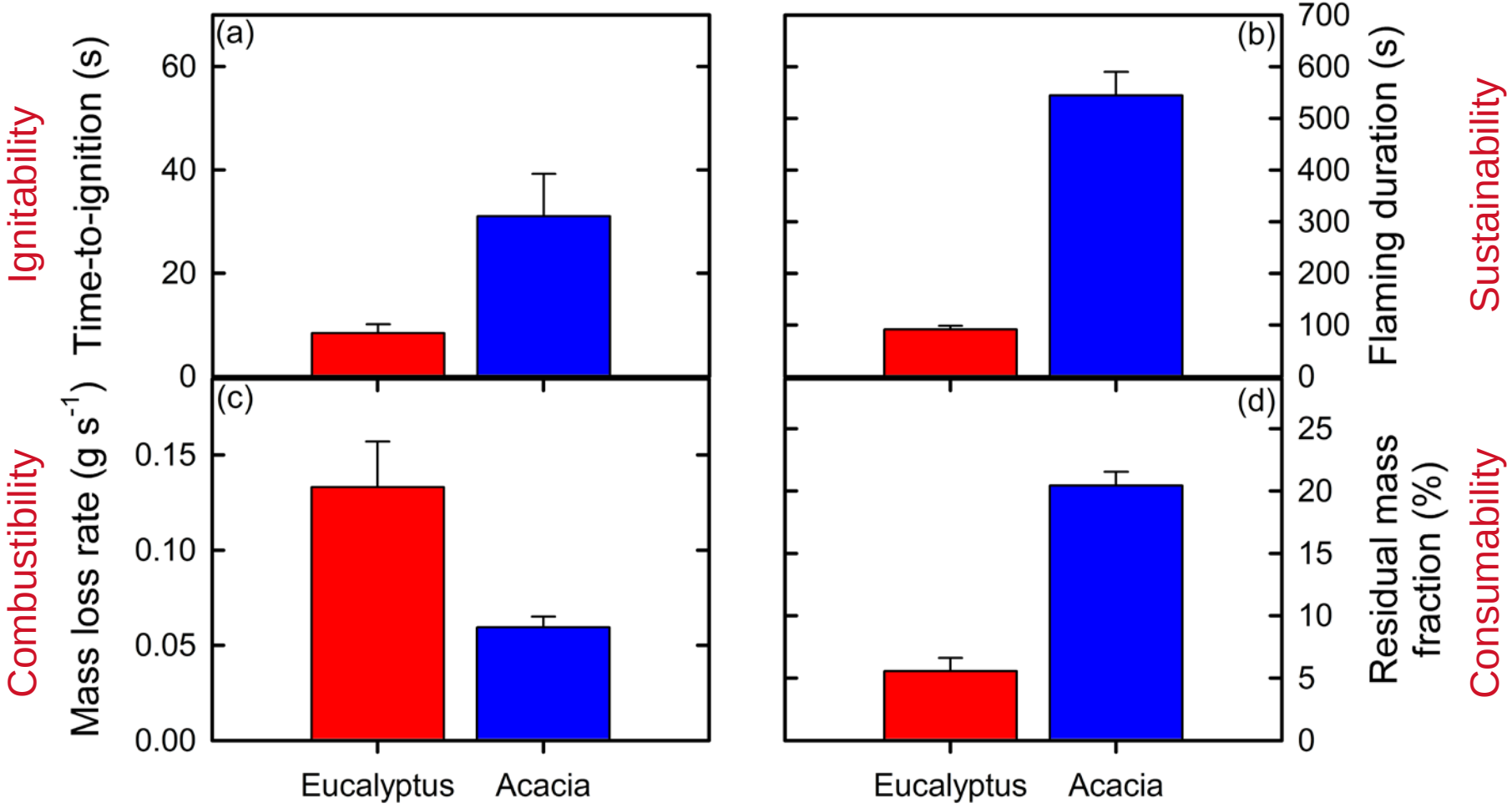

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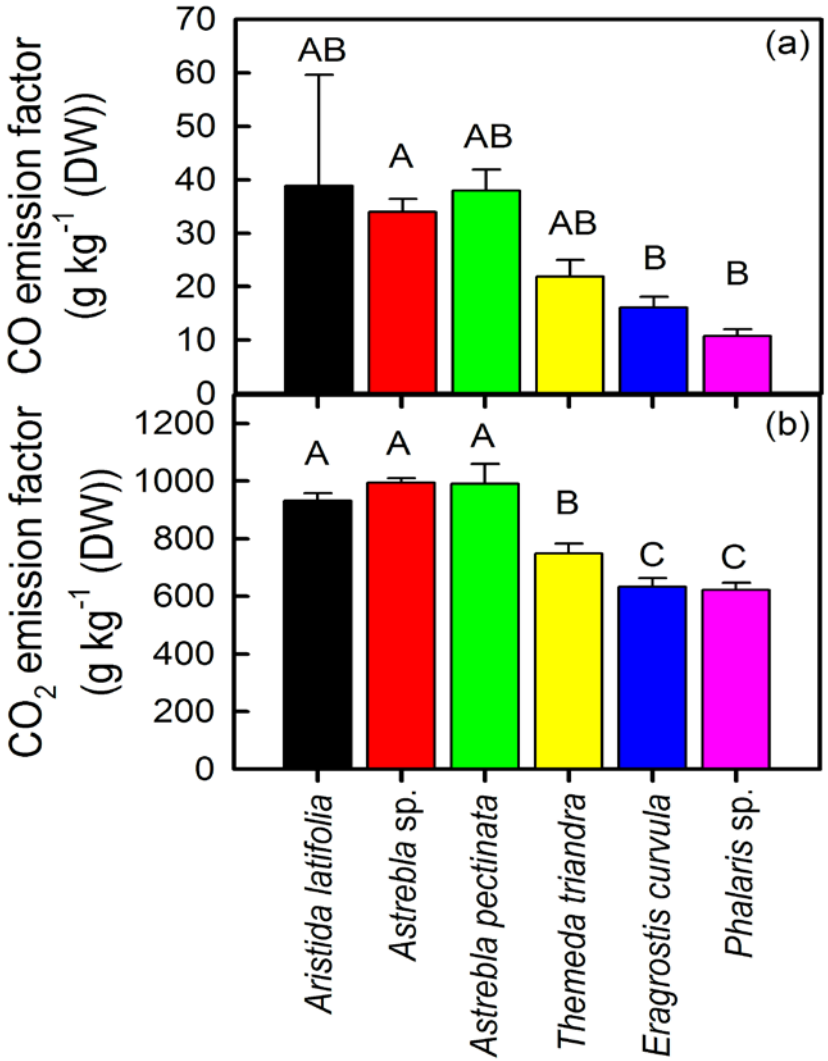
Experiment 4: Smoke composition and flammability of sub-tropical and temperate grasses

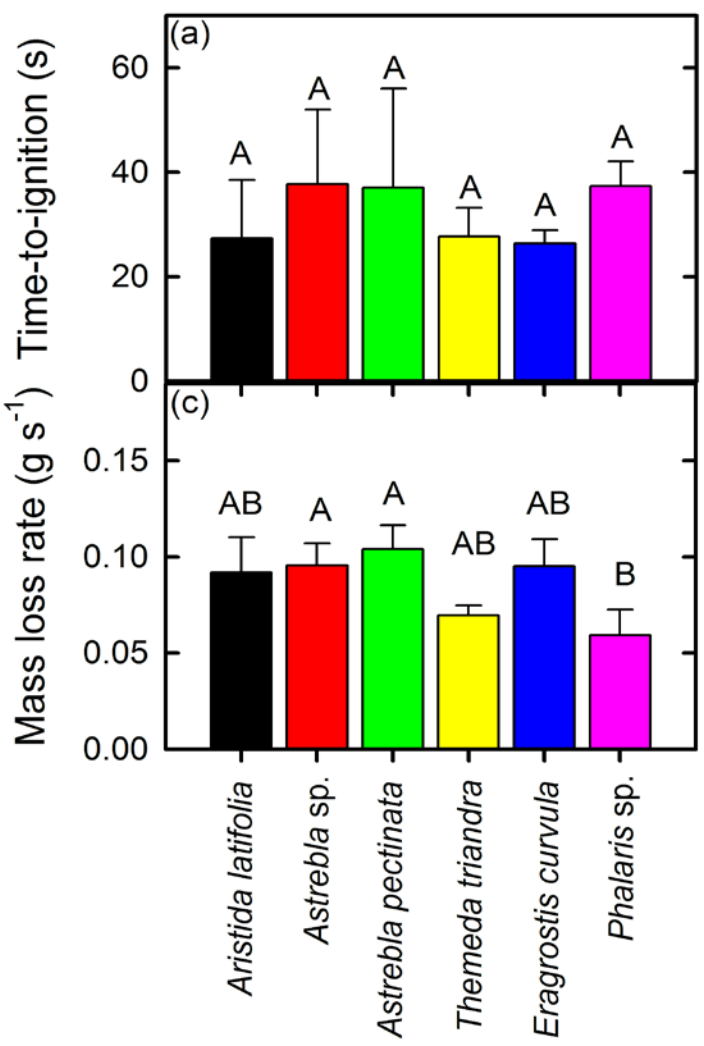


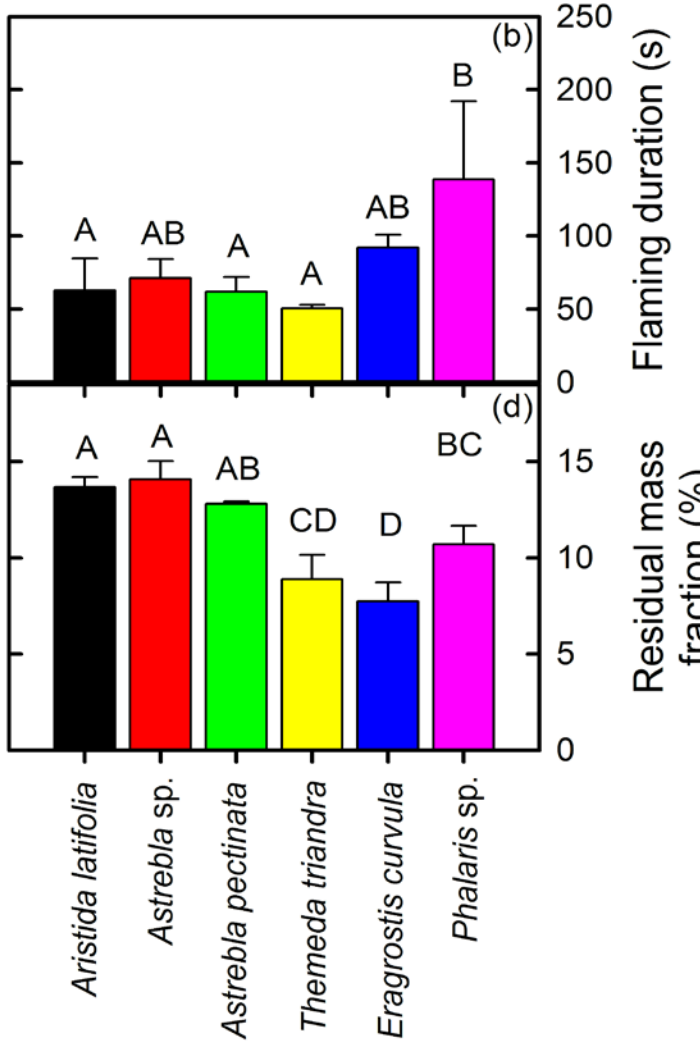
Figures: Possell and Bell (submitted)

Experiment 4: Smoke composition and flammability of sub-tropical and temperate grasses

Ignitability

Combustibility





Sustainability

Consumability

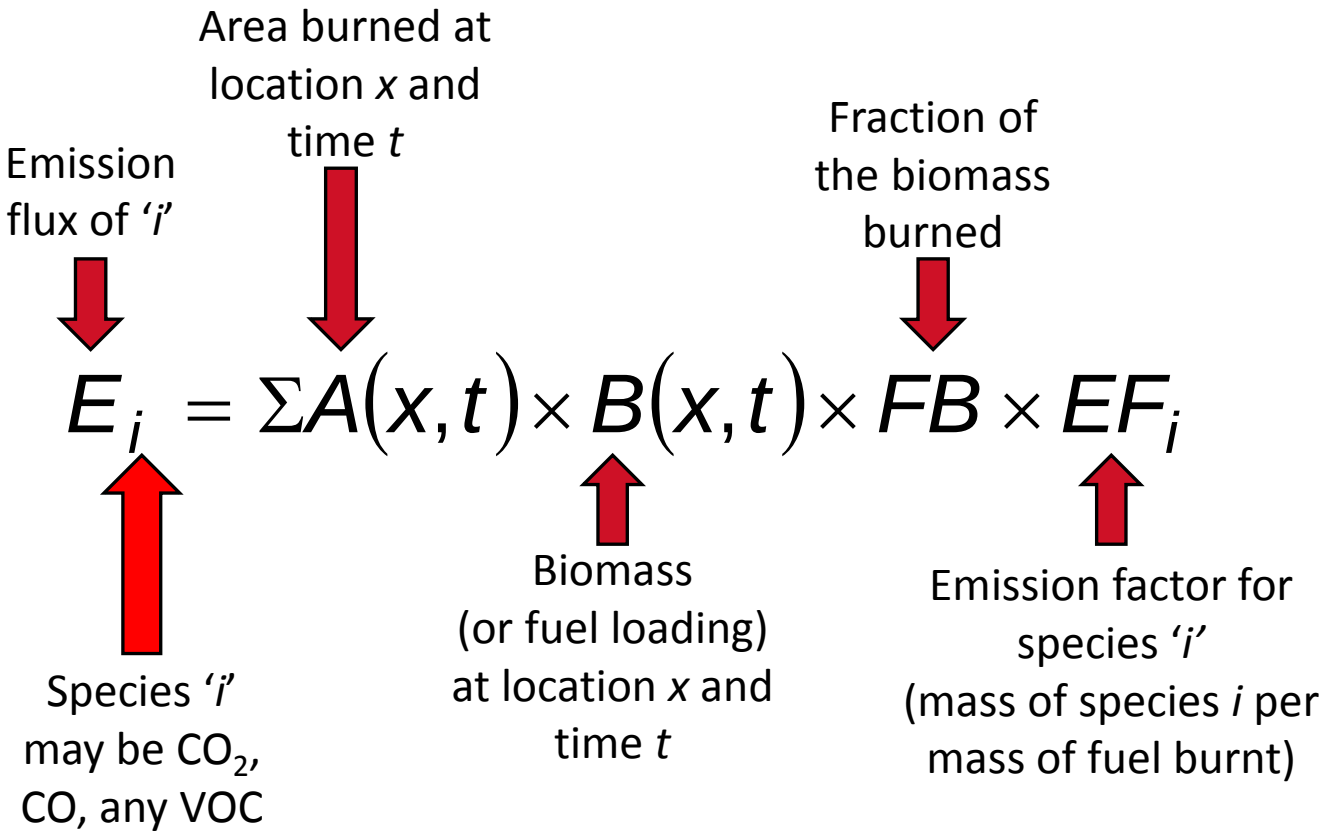
Figures: Possell and Bell (submitted)

Experiment 5: Effect of land management practices on flammability and gas emissions

- Seven plots:
  - 4 in *Phalaris* (pasture grass) and 3 in *Themeda* (native)
- Each plot has a burnt and unburnt treatment
- Measurements of dry weights, fuel moisture content, hazard scores and grass heights were made before treatment, after treatment and will be made again in January 2013.
- Emission factors and flammability components will be measured in January 2013

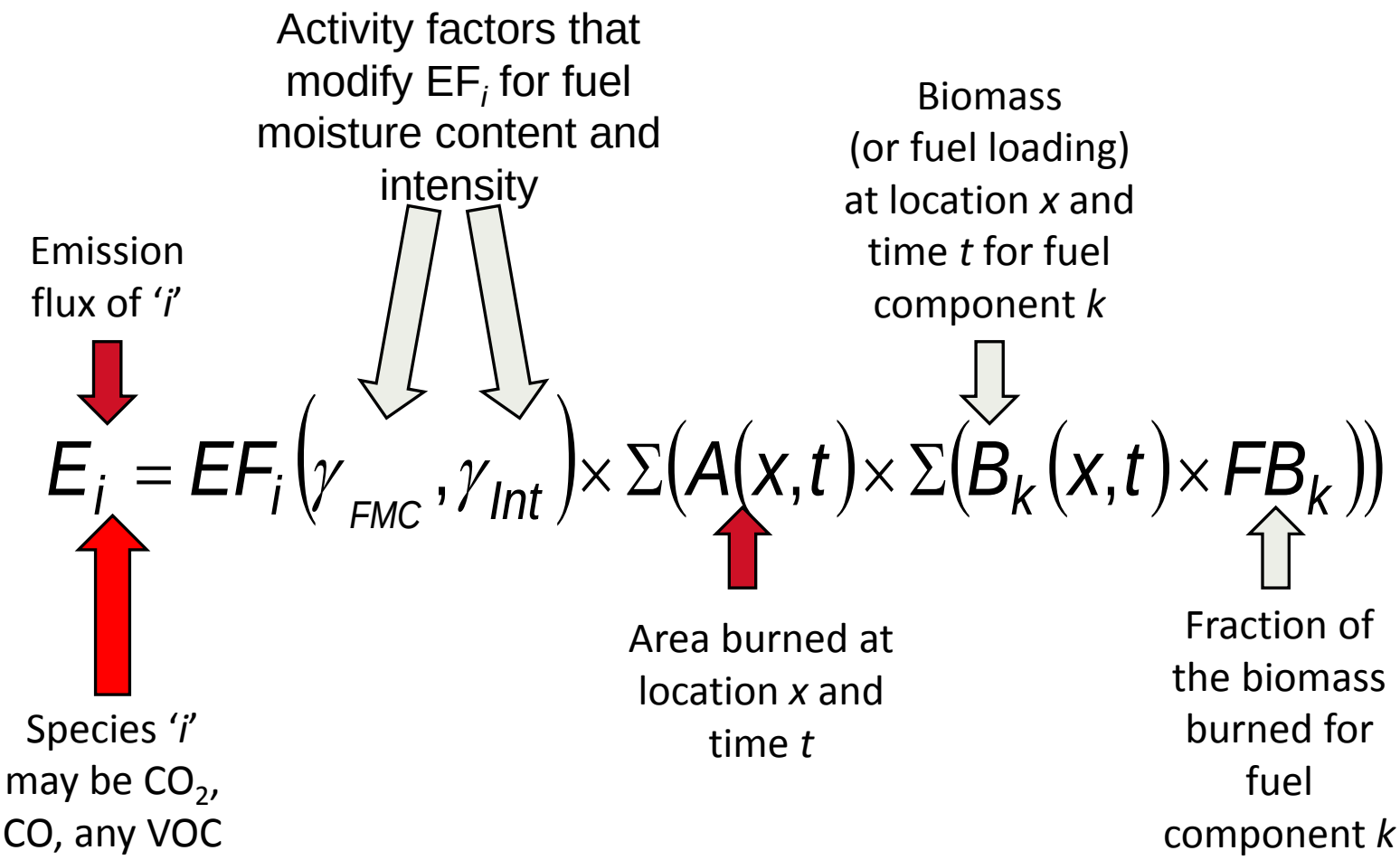
Actual and potential outputs (the next 11 months)

Simplified version of current emission models:



Actual and potential outputs (the next 11 months)

Potential for improved emission model:



Actual and potential outputs (the next 11 months)

- Database of emission factors of CO_2, CO, VOCs for different components of different Australian plant species
- Experiment 3, combined with other data from the ARC linkage grant, will give us an estimate of carbon balance from prescribed burning
- Experiment 1 is published in International Journal of Wildland Fire (http://dx.doi.org/10.1071/WF12077)

Acknowledgments

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- **ARC Linkage grant with DSE (Experiment 3)**