Presentation made at the Savanna Fire – Ecology, Culture, Economy Forum May 7th 2008

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Fuels Fires and Greenhouse Gases

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CSIRO

Talk outline

- **Fires**
  - Australian fires in perspective
  - The combustion process
- **Fuels**
  - Production and decomposition
  - Relationship to vegetation dynamics
- **Greenhouse management**

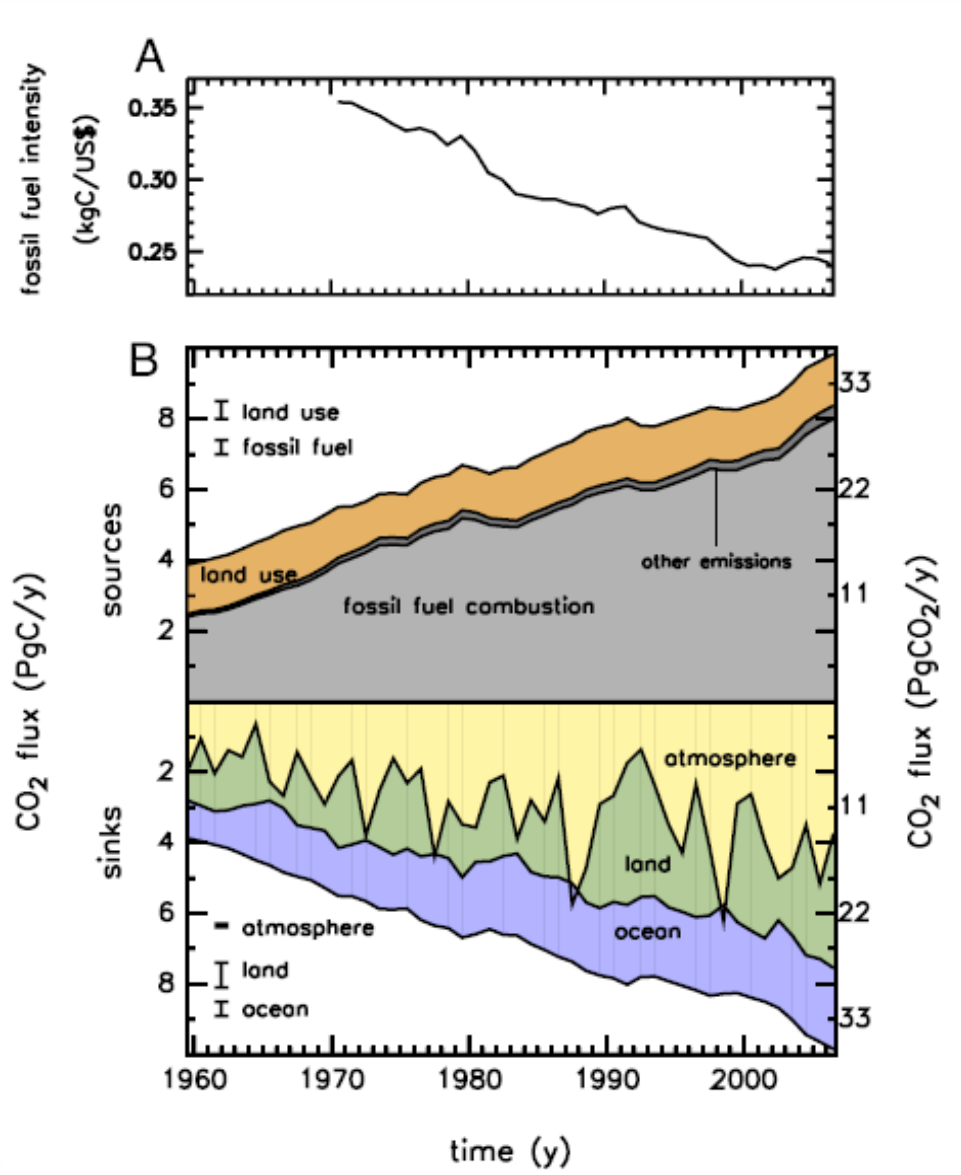
Growth in Atmospheric CO_2

1980s: 1.49 ppm y^{-1}

1990s: 1.58 ppm y^{-1}

2000s: 1.93 ppm y^{-1}

Canadel et al. 2007



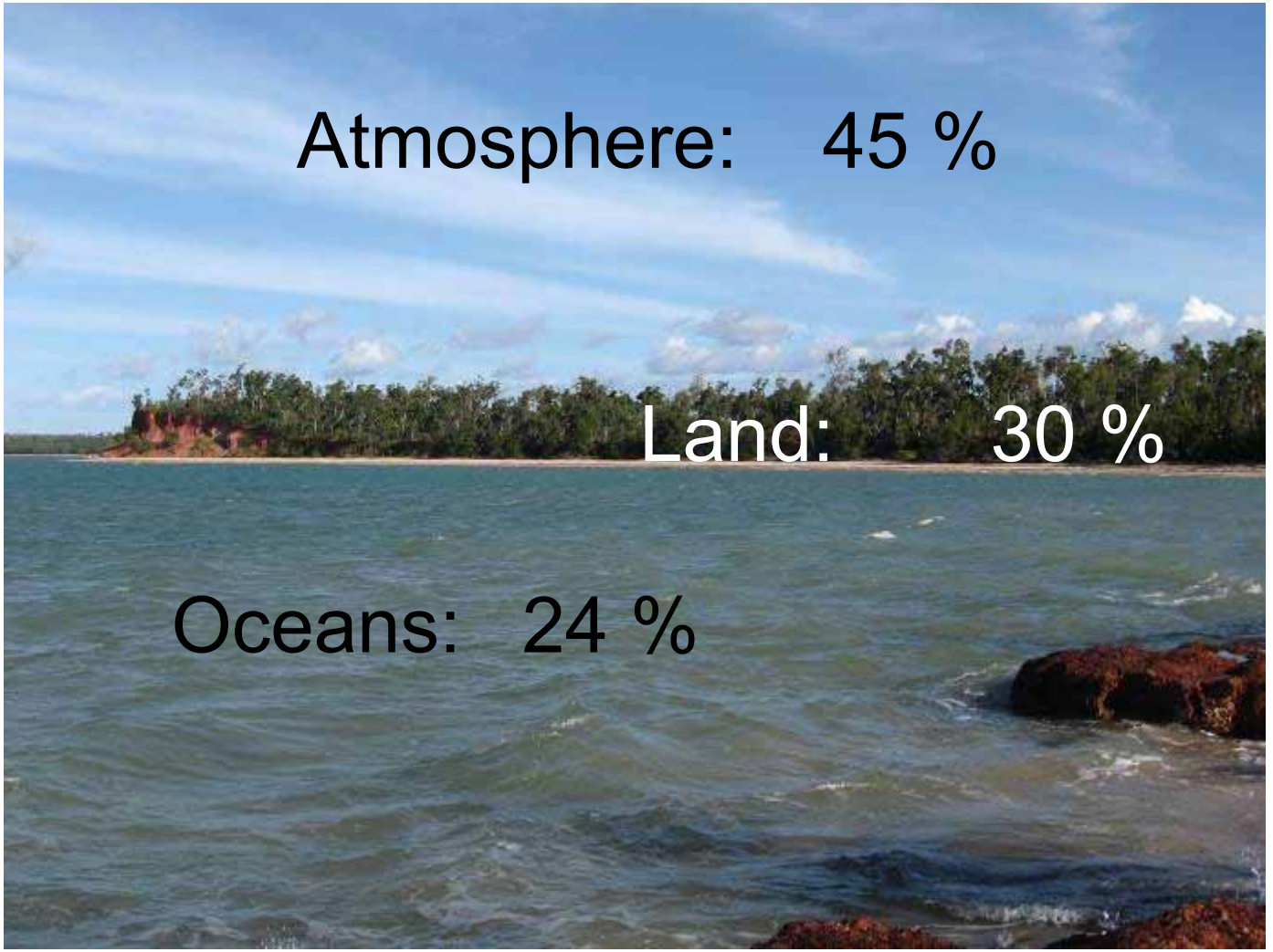
Overall emissions budget: 2007 9.1 Pg C y^{-1}

- **Emissions intensity**
  - (C / US$)
  - declining slowly, but may be increasing again
- **Economic growth rising sharply**
- **Terrestrial sink strength slowing**

The cost of the carbon economy

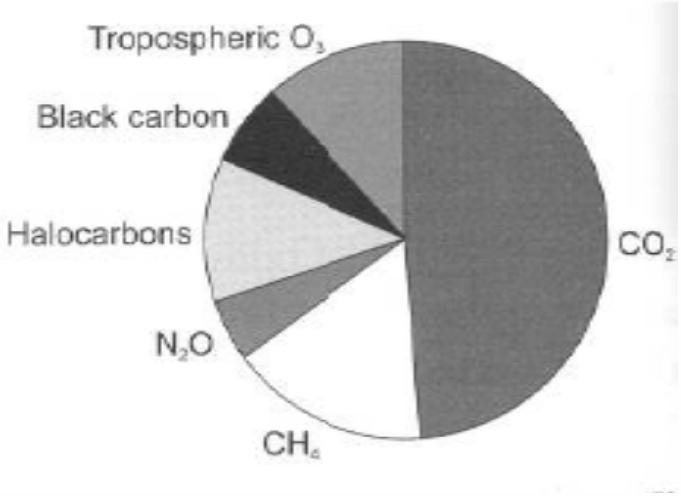
- **Emissions intensity**
  - 0.25 kg C/ US$
- **Benefit from carbon**
  - US$4000 GWP / t C
- **Payment for foregoing that benefit**
  - Spot price US$37 / t C

Where does 9.1 Pg C y^{-1} go?



Types of greenhouse gases

	Pre-ind	Current	Warming potential
CO_2	280	375	1
CH_4	0.8	1.8	21
N_2O	0.28	0.31	310



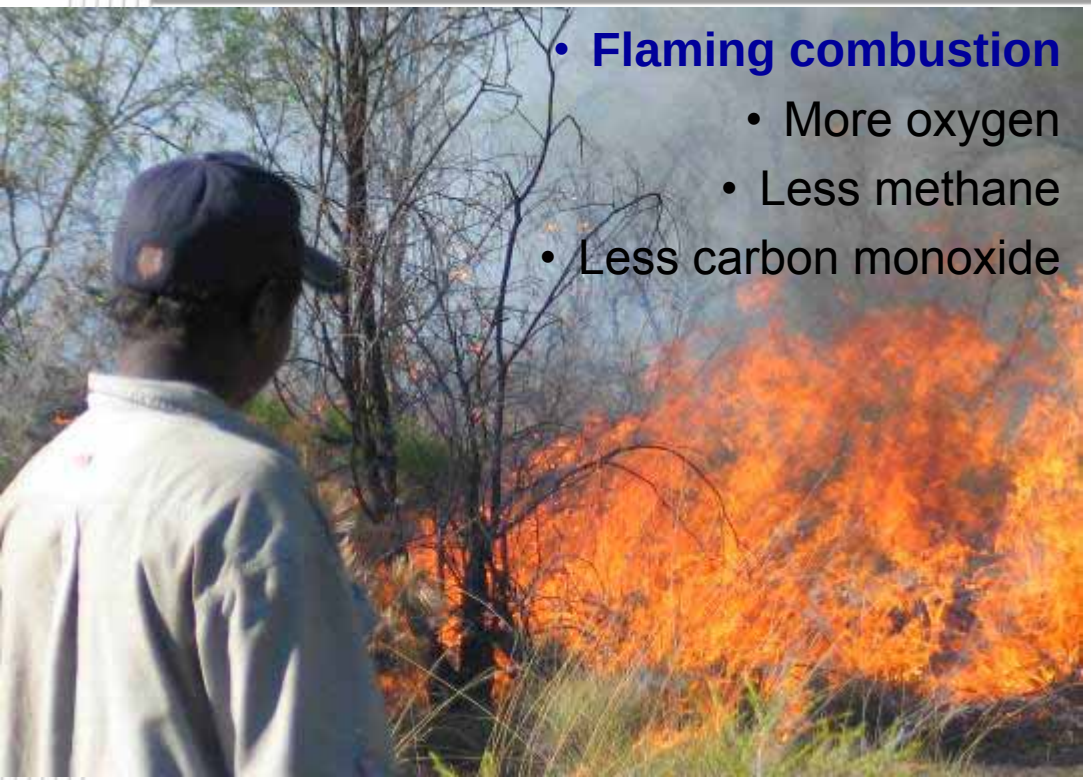
Australian fires in perspective

- **Globally 5.6 x 10^{15} g biomass burnt per year**
- **Australia 0.3 – 0.5 x 10^{15} g**
  - Meyer et al. 2008
- **Estimated Australian CO_2 emissions (Hurst et al. 1994)**
  - Biomass Fires: 82 Tg C
  - Fossil fuels: 71 Tg C

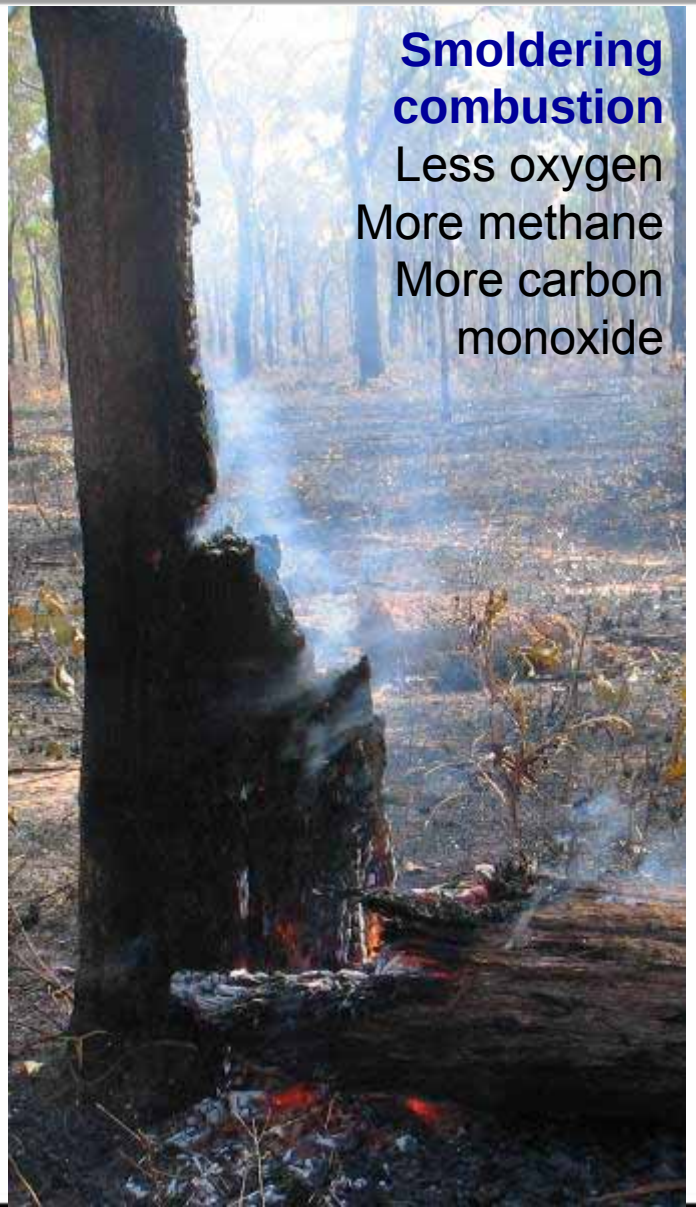
Measured emissions

Vegetation type	Emission factor: Methane
Savanna	0.0035
Southern Forest	0.0054

The combustion process



- **Flaming combustion**
  - More oxygen
  - Less methane
  - Less carbon monoxide



Smoldering combustion
Less oxygen
More methane
More carbon monoxide

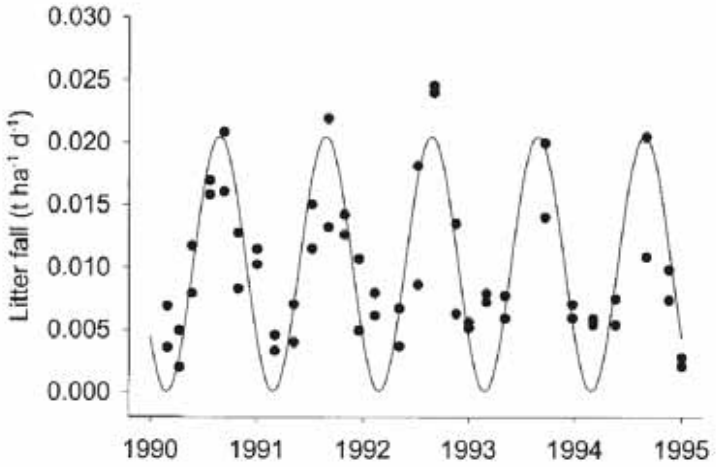
$\Delta CO/\Delta CO_2$

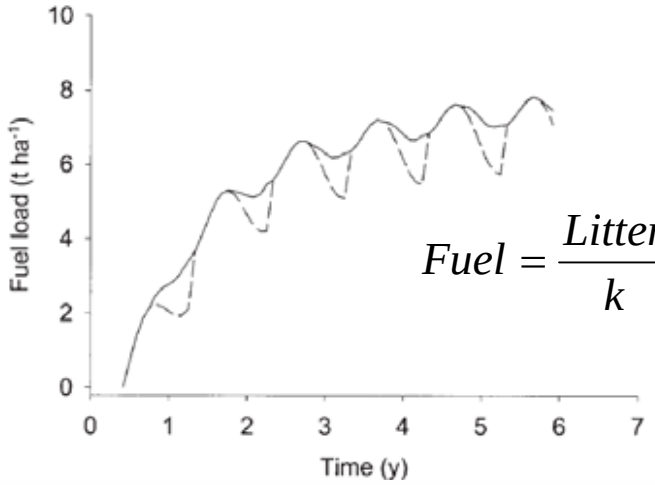
Flaming =	0.055
Smoldering =	0.168
Plume =	0.09

C. 70 % Flaming

How fire abatement reduces emissions

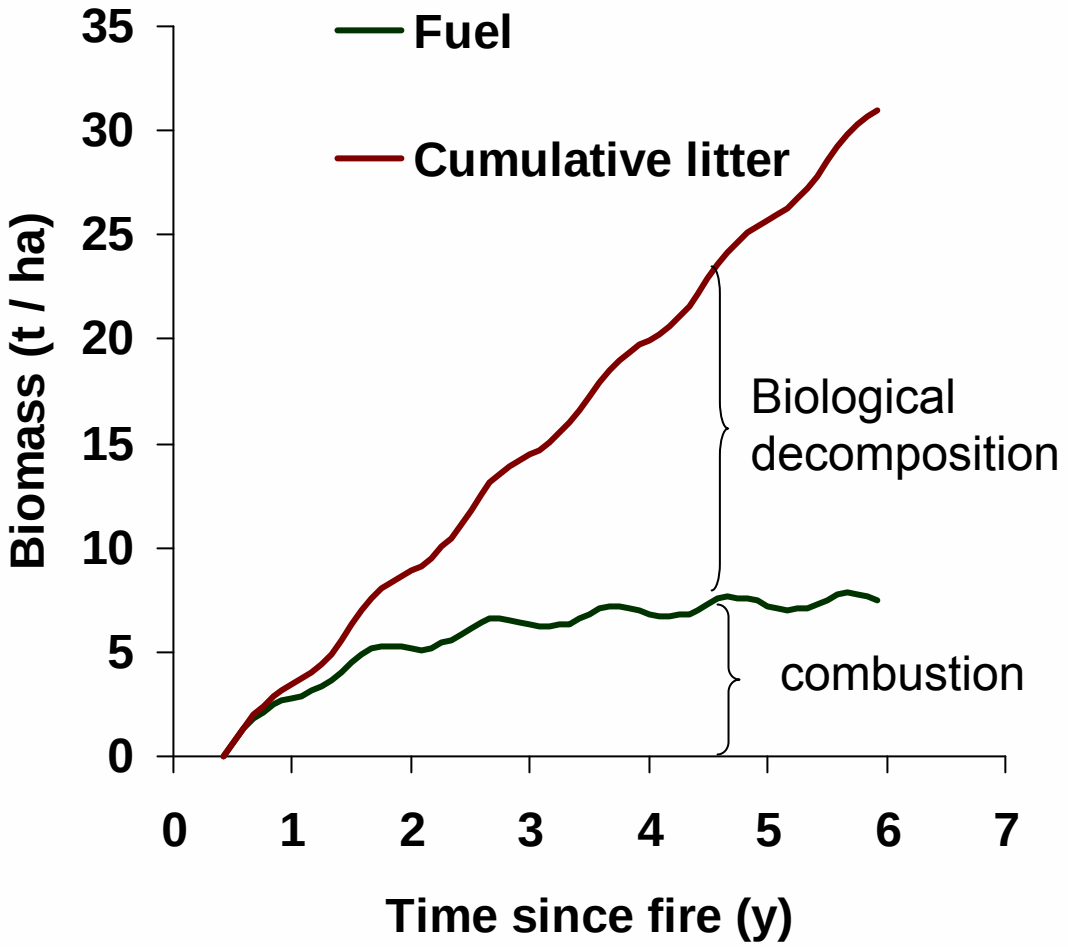
- **Need to understand fuel dynamics**
  - Fine fuel
  - Litter from trees
    - Leaves, twigs
  - Grass



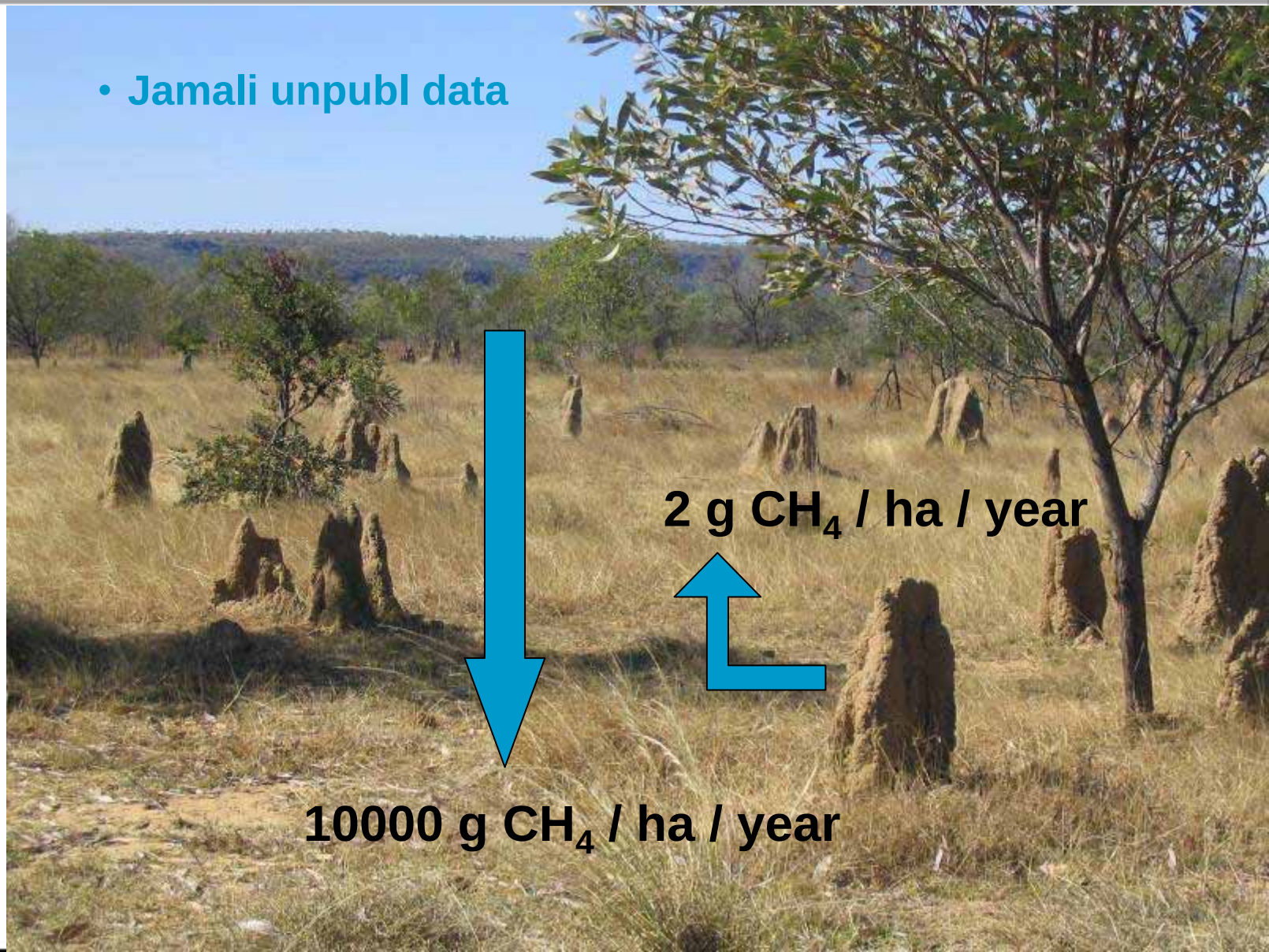


$$Fuel = \frac{Litter}{k}\left(1 - e^{-kt}\right)$$

How fire abatement reduces emissions



What about decomposition?



And if burnt?

c. 14 000
g CH_4 / ha / fire

Woody debris

- **Stock of coarse woody debris**
  - 4.5 t C/ha
- **Annual wood production (excl termite consumption)**
  - 0.8 t C/ha
- **Y = L/k**
  - K = 0.18
- **About 17 years to reach 95 % of equilibrium value**
- **Annual wood combustion**
  - C. 0.8 t C /ha

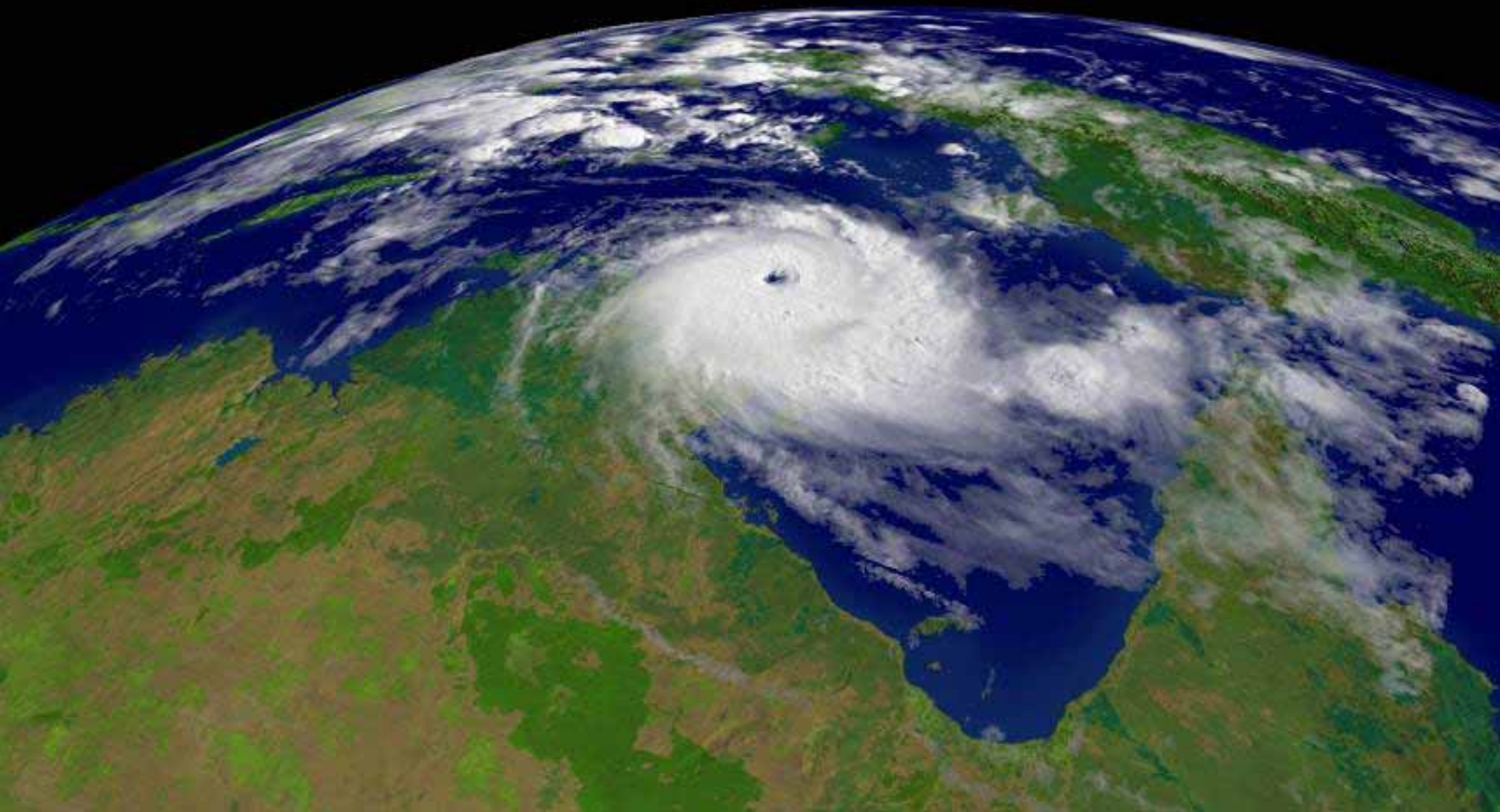
Coarse woody debris

- **Kapalga fires**
  - C. 70 % flaming
  - C. 30 % smoldering
  - Coarse woody debris combustion: c. 1.0 - 1.5 t C / ha

What about the risk?

Cyclone Monica knocked over about 7000 km² of trees

Equivalent to about 10 % of Australia's annual GHG emissions



Tree damage: risk or opportunity

Wind throw: a recurrent disturbance

- **The saplings had been killed by a bush fire, and a hurricane, which must have swept over the country some years ago, had broken and uprooted the larger trees, which lay all to the west and north–west. Since then, saplings had sprung up, and, with the remains of the old trees, formed a most impervious scrubby thicket, through which we could move but very slowly.**
  - Ludwig Leichardt Oct 3 1845

WALFA rationale

- **Primarily emissions abatement**
  - Optimising management of savannas for emissions reductions
  - An emissions abatement effort appropriate to northern Australia
- **Not primarily about carbon sequestration**
  - Qualitatively different to tree planting
- **Tree damage creates need and opportunity for even greater attention to emissions reduction**

IPCC guidelines

- **1996**
  - Partial carbon account
    - CH_4 and N_2O
- **2006**
  - Towards full carbon account
    - CH_4 and N_2O
    - CO_2 flux
- **Can now take account of effects of fire regime on Carbon stocks**

Further work

Ozone precursors
Aerosols
CO2
Fuel dynamics, especially woody debris
Robust, routine assessment: top down meets bottom up

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Thank you

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