

# Smoke composition and flammability of tropical and temperate grasses

FACULTY OF AGRICULTURE & ENVIRONMENT

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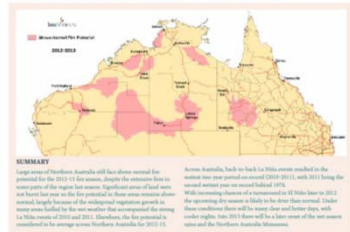
## Risk of grass fires

Development of fire risk assessment for the bushfire CRC research project

**FIRE NOTE**

ISSUE 92 | AUGUST 2012

### NORTHERN AUSTRALIAN SEASONAL BUSHFIRE ASSESSMENT 2012



**RESEARCH POTENTIAL**

Bushfire potential depends on several factors. The relative location and timing of rainfall are critically important when estimating fuel volume and growth. This also affects the timing of the burning that is the drying of the fuel.

The climate outlook for the next few months is also a critical factor of particular concern as the latest outlooks of the 12-18 month outlooks, a major climate driver over Australia. Other key variables include soil moisture and the distribution and condition of bushfire vegetation, are also considered.

Members of the Northern Australian Fire Management Group have, chaired by Bushfire CRC Deputy CEO Dr. David Thomson, met in Darwin at the offices of the Queensland Fire and Rescue Service in late June. During the proceedings they discussed the seasonal outlook for the summer fire season, including the provision of this Fire Note.

Discussion included representation of the Bureau of Meteorology, Professor V.C. Northon, Territory Fire and Rescue Services, Western Australia Fire and Emergency Services Authority and Department of Environment and Conservation, University of Western Australia,

CSIRO, Charles Sturt University, the Health Queensland Regional Operations of Council, Ipswich City Council, the Australian Fire and Emergency Services Authority Council, Queensland Fire and Rescue Service and Queensland Parks and Wildlife Service.

The seasonal bushfire outlook provides information to assist fire authorities in making strategic decisions such as resource planning and potential fire management, and to reduce the negative impacts of bushfire.

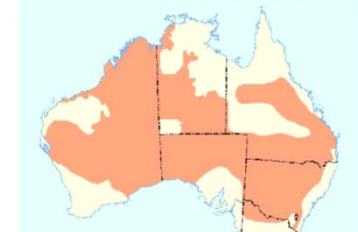
A seasonal bushfire outlook for western Australia will be distributed in late August.

Development of fire risk assessment for the bushfire CRC research project

**FIRE NOTE**

ISSUE 96 | AUGUST 2012

### SOUTHERN AUSTRALIAN SEASONAL BUSHFIRE OUTLOOK 2011-12




**INTERPRETATION**

A thick, full band of grass stands across much of the middle of Australia from the Indian Ocean to the west to the Pacific Ocean in southern Queensland and the Great Dividing Range in New South Wales. The grass is wet and more abundant than in previous years because of the heavy rains that accompanied the very strong La Niña event at the beginning of 2011.

With much of this grass now coming to the end of its growth cycle, the potential exists for above-normal bushfire activity across the areas of Australia during the 2011-12 southern fire season.

These expectations concern the extent of the outbreak at the bushfire Seasonal Bushfire Assessment Workshop held in Adelaide on 23 and 24 August and chaired by Bushfire CRC, Assistant Chief Officer of the Country Fire Service, South Australia. The workshop supported by the Bushfire CRC, brought fire and land managers, climatologists



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## Previous studies

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 115, D06314, doi:10.1029/2009JD11309, 2010

**Trace gas emissions from savanna fires in northern Australia**  
C. Paton-Walsh,<sup>1</sup> N. M. Deutscher,<sup>1</sup> D. W. T. Griffith,<sup>1</sup> B. W. Forgan,<sup>2</sup> S. R. Wilson,<sup>1</sup> N. H. Jones,<sup>1</sup> and D. P. Edwards<sup>3</sup>

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 108, NO. D1, 4096, doi:10.1029/2001JD000841, 2003

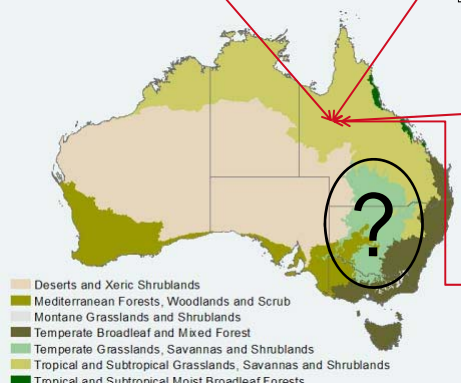
**Emission estimates of selected volatile organic compounds from tropical savanna burning in northern Australia**  
T. Shirai,<sup>1</sup> D. R. Blake,<sup>2</sup> S. Meinardi,<sup>2</sup> F. S. Rowland,<sup>2</sup> J. Russell-Smith,<sup>3</sup> A. Edwards,<sup>1</sup> Y. Kasilo,<sup>4</sup> M. Kozak,<sup>4</sup> K. Kim,<sup>4</sup> T. Machida,<sup>5</sup> N. Takegawa,<sup>6</sup> N. Nishi,<sup>2</sup> S. Kawakami,<sup>1</sup> and T. Ogawa<sup>4</sup>

Journal of Atmospheric Chemistry 10: 13-56, 1994.  
© 1994 Kluwer Academic Publishers. Printed in the Netherlands.

**Measurements of Trace Gases Emitted by Australian Savanna Fires During the 1990 Dry Season**  
DALE F. HURST and DAVID W. T. GRIFFITH  
Department of Chemistry, University of Wollongong, Wollongong, NSW, 2522, Australia  
JOHN N. CARRAS and DAVID J. WILLIAMS  
CSIRO Division of Coal and Energy Technology, North Ryde, NSW, 2113, Australia  
PAUL J. FRASER  
CSIRO Division of Atmospheric Research, Aspendale, VIC, 3790, Australia

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 99, NO. D8, PAGES 16443-16456, AUGUST 20, 1994


**Trace gas emissions from biomass burning in tropical Australian savannas**  
Dale F. Hurst<sup>1</sup> and David W. T. Griffith  
Department of Chemistry, University of Wollongong, Wollongong, New South Wales, Australia  
Garry D. Cook  
CSIRO Tropical Ecosystems Research Centre, Darwin, Northern Territory, Australia



- Deserts and Xeric Shrublands
- Mediterranean Forests, Woodlands and Scrub
- Montane Grasslands and Shrublands
- Temperate Broadleaf and Mixed Forest
- Temperate Grasslands, Savannas and Shrublands
- Tropical and Subtropical Grasslands, Savannas and Shrublands
- Tropical and Subtropical Moist Broadleaf Forests


<http://www.environment.gov.au/parks/nrs/science/bioregion-framework/terrestrial-habitats.html>

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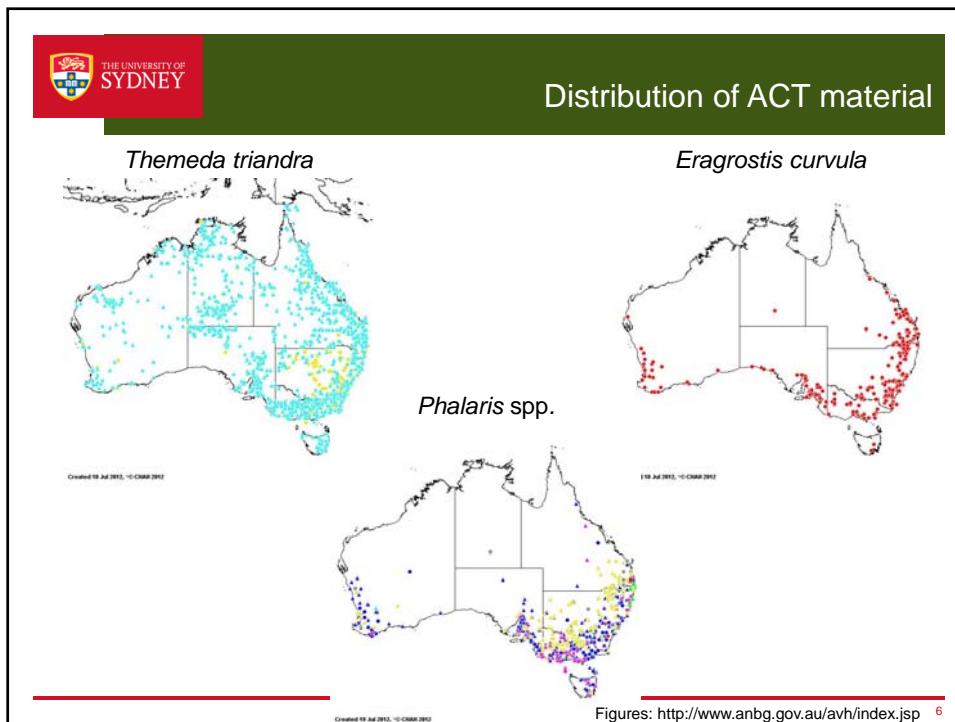
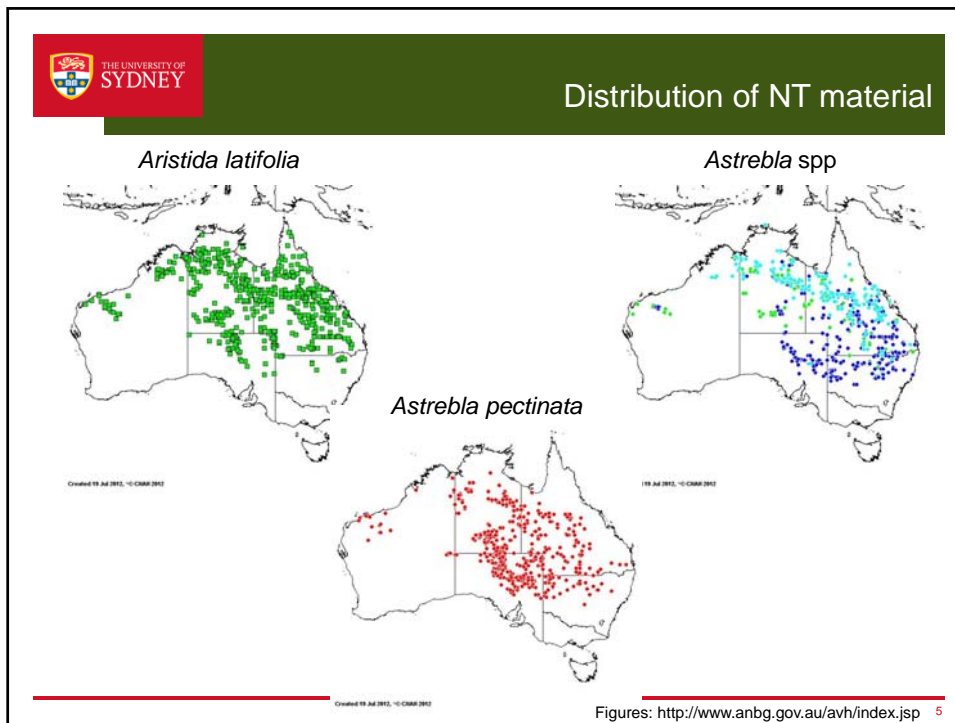
## Study locations




© 2012 Whereis® Sansis Pty Ltd  
Data SIO, NOAA, US Navy, NGA, GEBCO  
© 2012 Google  
US Dept of State Geographer  
27°34'04.34" S 134°43'08.19" E elev. 167 m

Google earth  
Eye at 6690.33 km

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## Smoke composition and flammability measurements


**IRGAs:**  
CO<sub>2</sub> and CO concentrations





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

**PTR-MS:**  
VOC measurements









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## Definitions

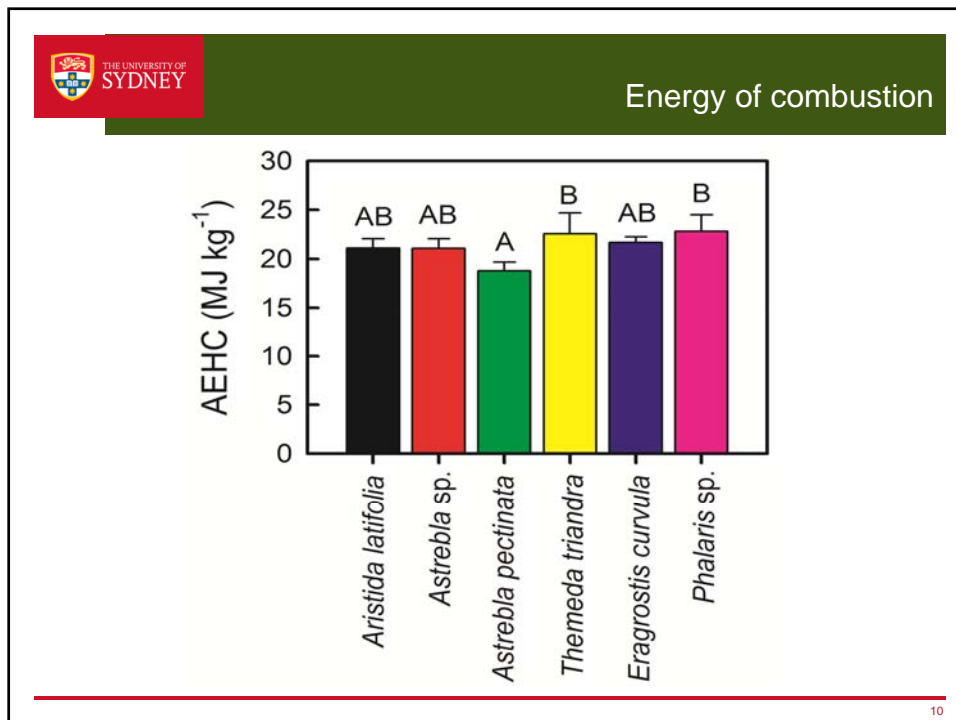
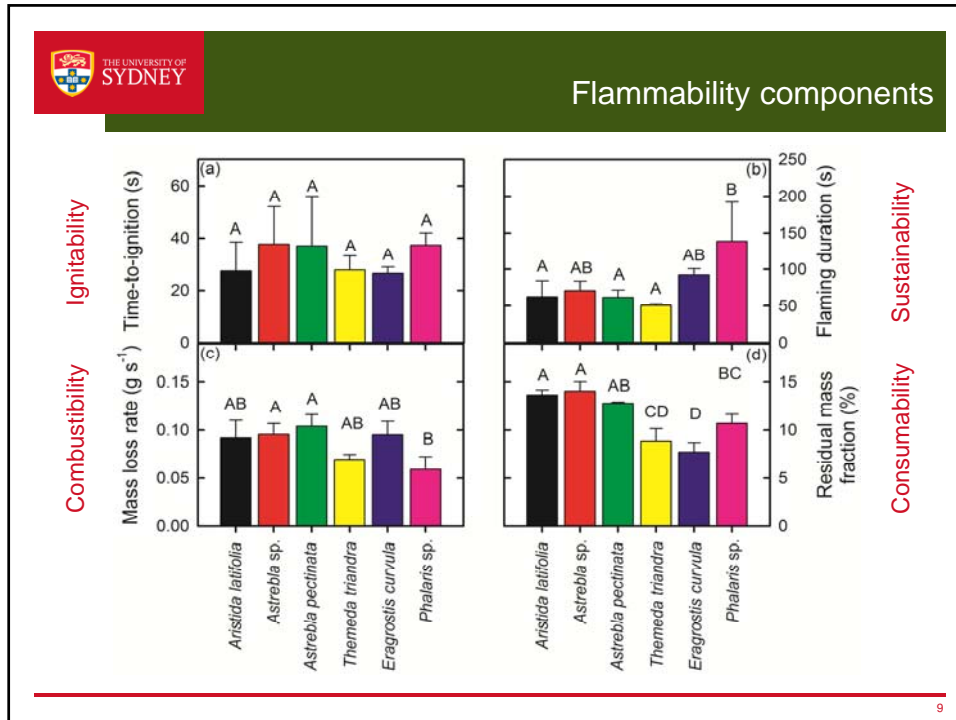
**Flammability** (Anderson, 1970; Martin *et al.* 1994)

1. Ignitability: time taken until ignition on exposure to a heat source
2. Sustainability: the ability to maintain fire once it is ignited
3. Combustibility: rate of burning after ignition
4. Consumability: proportion of mass or volume consumed by fire

**Emission factor**

- The amount of a given compound released per amount of dry fuel consumed

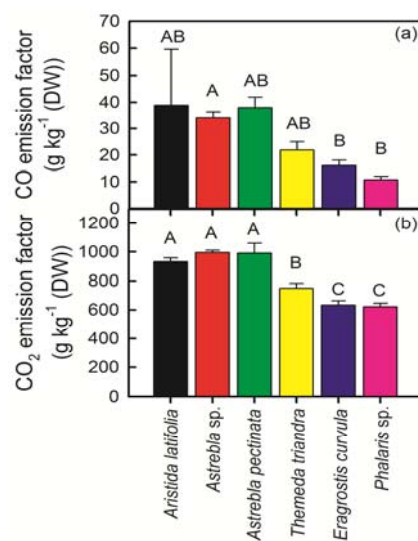
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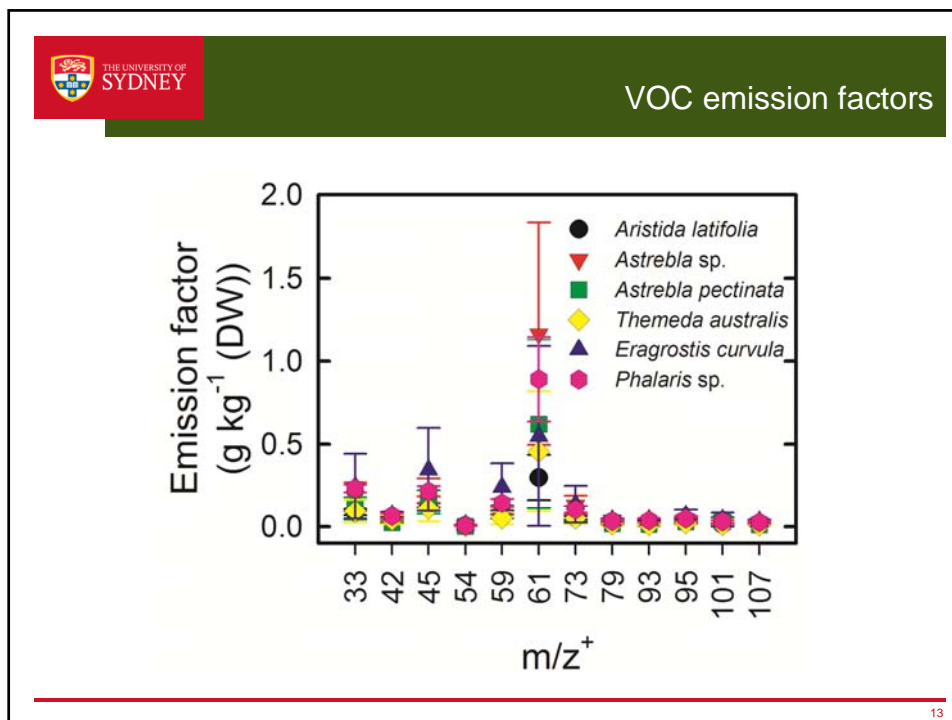
## Multi-criteria analysis of flammability


Species	Normalised scores <sup>a</sup>					Total	Rank
	Time-to-ignition	Flame duration	Mass-loss rate	Residual mass fraction			
<i>Aristida latifolia</i>	91.18	13.96	73.17	6.22	46.13	3	
<i>Astrebula sp.</i>	0	23.40	81.28	0	26.17	6	
<i>Astrebula pectinata</i>	5.88	13.21	100.00	20.12	34.80	5	
<i>Themeda triandra</i>	88.24	0	23.04	81.98	48.32	2	
<i>Eragrostis curvula</i>	100.00	47.17	80.02	100.00	81.80	1	
<i>Phalaris sp.</i>	2.94	100.00	0	53.31	39.06	4	

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CO<sub>2</sub> and CO emission factors

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 VOC emission factors

Compound(s) <sup>a</sup>	Australian savanna and grassland		Global savanna and grassland	
	This study	Shirai et al. (2003)	Akagi et al. (2011)	Andreae and Merlet (2000)
Methanol <sup>b</sup>	0.162 ± 0.107	-	1.18 ± 0.41	1.30
Acetonitrile <sup>b</sup>	0.049 ± 0.023	-	0.11 ± 0.07	0.11
Acetaldehyde <sup>b</sup>	0.198 ± 0.130	-	0.57 ± 0.30	0.50 ± 0.39
Acrylonitrile <sup>b</sup>	0.004 ± 0.002	-	0.05 ± 0.02	-
Acetone <sup>b</sup>	0.120 ± 0.086	-	0.16 ± 0.13	0.25 - 0.62
Acetic acid <sup>d</sup>	0.684 ± 0.485	-	3.55 ± 1.47	1.30
Methyl ethyl ketone <sup>b</sup>	0.094 ± 0.061	-	-	0.26
Benzene <sup>b,c</sup>	0.028 ± 0.001	0.035 ± 0.004	0.20 ± 0.08	0.23 ± 0.11
Toluene <sup>b,c</sup>	0.024 ± 0.014	0.012 ± 0.001	0.08 ± 0.07	0.13 ± 0.06
Phenol <sup>b</sup>	0.040 ± 0.022	-	0.52 ± 0.36	0.003
Methyl isobutyl ketone <sup>b</sup>	0.028 ± 0.023	-	-	-
Xylenes <sup>b,c</sup>	-	-	-	-
Ethylbenzene <sup>b</sup>	0.018 ± 0.001	-	-	-
Benzaldehyde	-	-	-	-

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## Summary

- There are a number of differences in the components of flammability and emission factors between grass species.
- Except for the emission factors for CO<sub>2</sub>, no obvious patterns between the grasses were measured.
- The invasive grass has the potential to be more flammable than the native grasses.
- More data is needed from other grass species.
- Do grasses from other grasslands behave the same?

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## Acknowledgments

- Bill Harney for access to his property in the Northern Territory
- **University of Sydney**

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Dr. Tony Winters	Vicky Aerts
Dr. Sebastian Pfautsch	Valerie Densmore
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Neil Cooper (Lead end user)	Adam Leavesley
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