

bushfire CRC

PROGRAM A

→ **SPATIAL TECHNIQUES FOR GRASSLAND CURING ACROSS AUSTRALIA AND NEW ZEALAND**

Danielle Martin^{1,2}, Ian Grant¹, Simon Jones² and Stuart Anderson³

¹Space Based Observations Section, Bureau of Meteorology, Melbourne.
²School of Mathematical and Geospatial Sciences, Royal Melbourne Institute of Technology, Melbourne.
³Ensis Forest Biosecurity and Protection, Scion, Christchurch, New Zealand.

Email: Danielle.Martin@bom.gov.au

bushfire CRC

PROGRAM A : Spatial techniques for grassland curing across Australia and New Zealand

→ **AIM**

To produce an enhanced satellite-based grassland curing index to estimate grassland curing robustly across Australia and New Zealand from vegetation indices.

bushfire CRC

PROGRAM A : Spatial techniques for grassland curing across Australia and New Zealand

→ **OUTLINE**

1. **BACKGROUND**
 - a) Grassland Curing
 - b) Fuel Moisture Content
 - c) Vegetation Indices
2. **METHODS**
3. **PRELIMINARY RESULTS**
 - a) Relationships between field and satellite measurements
 - b) Spectral Signatures of Grasslands
 - c) Sample of Spatial Curing product
4. **CONCLUSIONS**

bushfire CRC

PROGRAM A : Spatial techniques for grassland curing across Australia and New Zealand

→ **BACKGROUND**

Fuel Moisture Content

FMC is the percentage of water in vegetation

$$FMC (\%) = \left(\frac{\text{Wet weight} - \text{Dry weight}}{\text{Dry weight}} \right) \times 100$$

Fuel Moisture has a great impact on the drying of grass as it increases the specific heat and thermal conductivity of the grass, resulting in the need for more absorbed heat for the grass to reach ignition temperature (Garvey and Millie, 2001).

bushfire CRC

PROGRAM A : Spatial techniques for grassland curing across Australia and New Zealand

→ **Grassland Curing**

Green **Cured**

Dec 16 2005 Feb 21 2006

60% 82%

Curing %

Property	Vegetation Index	Past Studies that have utilized listed indices
Active Growth	NDVI	<ul style="list-style-type: none"> Allen et al., 2003) Tropical Savannas (NT, Australia) (Cheng, 2006) Rice fields (China) (Chuvpico et al., 2004) <u>Grasslands</u> (Spain) (Dilley et al., 2004; Patridge and Barber, 1988) <u>Grasslands</u> (VIC, Australia) (Lu et al., 2003) Woodlands/<u>Grasslands</u> (NSW, Australia) (Qi et al., 1994) (Huete, 1988) Cotton fields (Arizona, USA) (Rahman et al., 2003) Chaparral/<u>Grasslands</u> (California, USA)
	SRI	<ul style="list-style-type: none"> (Tucker, 1979) <u>Grasslands</u> (USA)
	EVI	<ul style="list-style-type: none"> (Sims and Gamon, 2003) Mixed species (California, USA) (Cheng, 2006) Rice fields (China)
Soil Correction	SAVI	Cotton fields/ <u>Grasslands</u> (Arizona, USA)
	MSAVI	Cotton fields (Arizona, USA)
	PVI	Cotton fields/ <u>Grasslands</u> (Arizona, USA)
	CAI	Cotton fields (Arizona, USA)
	(Wiegand et al., 1991)	Crops (Texas)
Atmospheric Correction	WDVI	Cotton fields (Arizona, USA)
	ARVI	Forests/ <u>Grasslands</u> (France)
	SARVI	Cotton fields/ <u>Grasslands</u> (Arizona, USA)
	AFVI	Burned Forests (Brazil)
Bulk Canopy Pigments/ Nitrogen	PBI	Chaparral/ <u>Grasslands</u> (California, USA)
	NDNI / NDLI	Chaparral (California, USA)
	CAI	Corn/Soybean fields (Japan)
Water Content	SRWI	Chaparral (California, USA)
	WBI	Chaparral/ <u>Grasslands</u> (California and San Diego, USA)
	NDWI	<ul style="list-style-type: none"> (Gao, 1996) Conifer forests (California and Colorado, USA) (Zarco-Tejada et al., 2003) Chaparral (California, USA)

bushfire CRC

PROGRAM A : Spatial techniques for grassland curing across Australia and New Zealand

→ **NDVI**

The range of available indices to assess curing in grasslands will depend on the spectral bands offered by the operational sensors.

One index produced from MODIS, which is suitable for curing assessment is the Normalised Difference Vegetation Index (NDVI)

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$

bushfire CRC

PROGRAM A : Spatial techniques for grassland curing across Australia and New Zealand

→ **METHODS**

Field

Fuel Moisture Content:

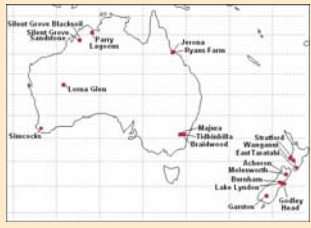
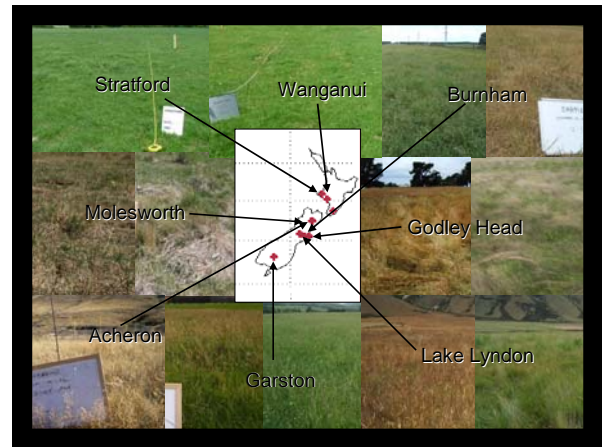
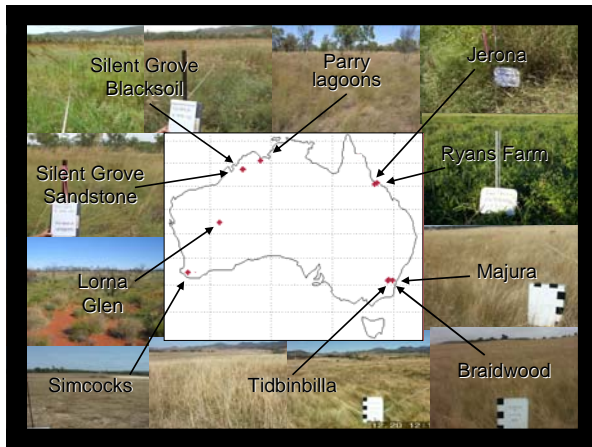
- Destructive sampling

Grassland Curing:

- Destructive sampling
- Visual observations
- Levy rod sampling

Satellite

A MODIS product was collected from the Land Processes Distributed Active Archive Center website (<http://edcdaac.usgs.gov/datapool/datapool.asp>): MOD09A1: 8-day 500m surface reflectance

bushfire CRC

PROGRAM A : Spatial techniques for grassland curing across Australia and New Zealand

→ **Spatial Homogeneity**

Questions

- How representative is a field site of one MODIS pixel?
- How sensitive is the MODIS measurement to variations in location of the MODIS pixel?
- Are there any locations in the vicinity of the sampling we should avoid?

Approach

Study the impact of spatial homogeneity by analysing a 25m Landsat image of the site

Create NDVI images from the Red and NIR Landsat bands

Measure the variation of 25m Landsat pixels:

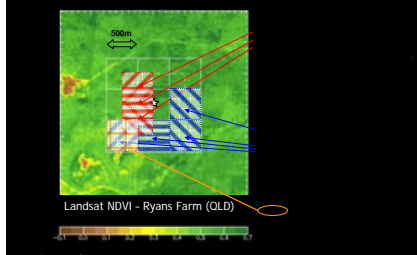
- within one MODIS 500m pixel
- between simulated MODIS 500m pixels

bushfire CRC

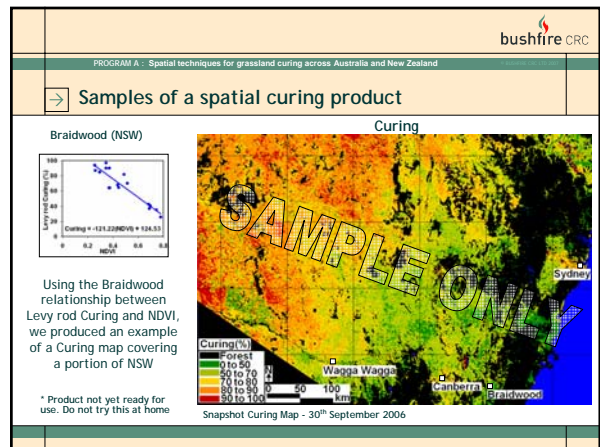
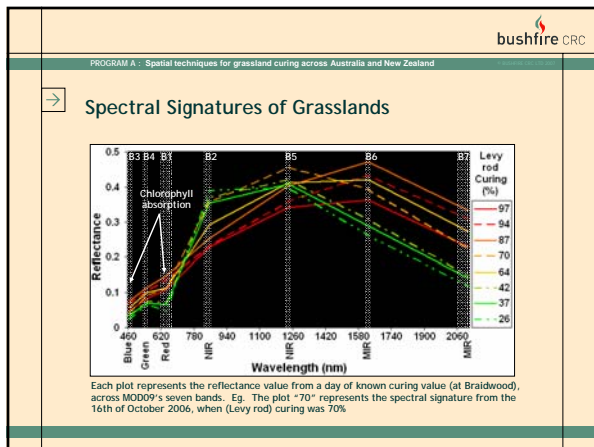
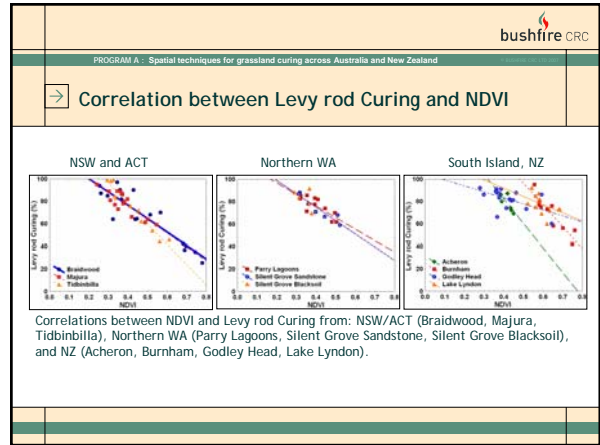
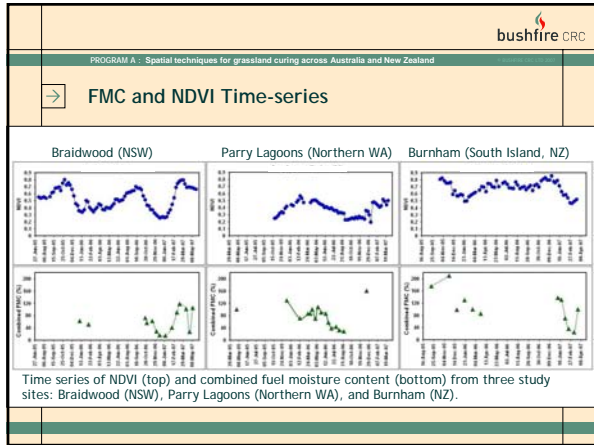
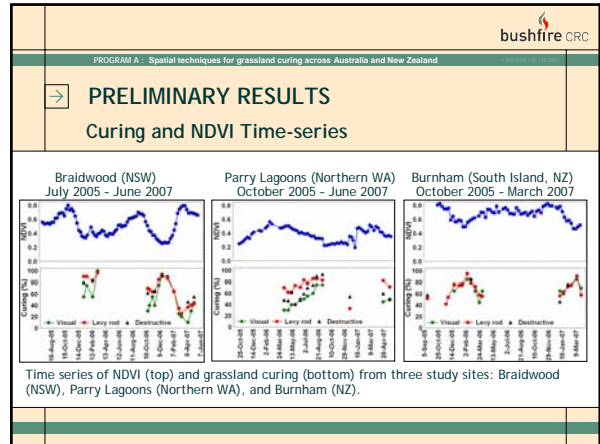
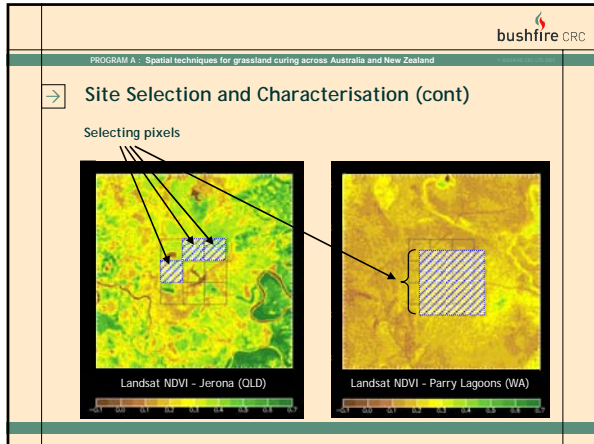
PROGRAM A : Spatial techniques for grassland curing across Australia and New Zealand

Site Selection and Characterisation

Site should be representative of the surrounding area of 1500 by 1500m



Landsat NDVI - Ryans Farm (QLD)



bushfire CRC

PROGRAM A : Spatial techniques for grassland curing across Australia and New Zealand

→ Samples of a spatial curing product (cont)

Change in Curing

Braidwood (NSW)

Using the Braidwood relationship again, this example shows the change in curing from the 30th September to the 16th of October

(Oct 16th minus Sep 30th)

* Product not yet ready for use. Do not try this at home

Change in Curing Map: 30th September 2006 to 16th October 2006

bushfire CRC

PROGRAM A : Spatial techniques for grassland curing across Australia and New Zealand

→ Samples of a spatial curing product (cont)

Date of Curing

Braidwood (NSW)

This map allows comparison of the progress of curing from one season to another

* Product not yet ready for use. Do not try this at home

Date when grasslands become 70% cured, from September 2005 to January 2006

bushfire CRC

PROGRAM A : Spatial techniques for grassland curing across Australia and New Zealand

→ CONCLUSION

The relationship between grassland curing and NDVI varied between sites due to climatic differences and variability in topography, soil type and grass type.

We will expand this study to understand these relationships across Australia and New Zealand, and assess the impact of grass and soil characteristics, with consideration of topography, climate and tree cover.

Information produced can be used for a range of fire management activities, such as prevention and preparedness planning, fire suppression operations, and for implementing controlled burning programs. It can also link in with other research and outputs from Bushfire CRC projects.

bushfire CRC

PROGRAM A : Spatial techniques for grassland curing across Australia and New Zealand

→ ACKNOWLEDGEMENTS

Space Based Observations Section, [Bureau of Meteorology](#)

School of Mathematical and Geospatial Sciences, [RMIT University](#)

This study is a part of the [Bushfire CRC](#) Project A1.4 *Improved Methods for the Assessment and Prediction of Grasslands Curing*

bushfire CRC

PROGRAM A : Spatial techniques for grassland curing across Australia and New Zealand

→ Combined FMC methods

Five separate live and dead grass samples were collected from each site, as well as five combined (live and dead) samples.

Samples were oven-dried and weighed.

Curing was calculated using the following formula:

$$\text{Curing (\%)} = \frac{(\text{Live FMC} - \text{Combined FMC})}{(\text{Live FMC} - \text{Dead FMC})} \times 100$$

bushfire CRC

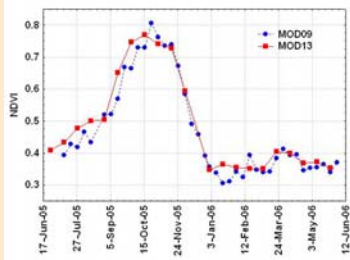
PROGRAM A : Spatial techniques for grassland curing across Australia and New Zealand

→ Isodata unsupervised classification

- calculates class means evenly distributed in the data space then clusters the remaining pixels using minimum distance techniques.
- All pixels are classified to the nearest class unless a standard deviation or distance threshold is specified, in which case some pixels may be unclassified if they do not meet the selected criteria.
- 12 classes were requested to use this classification to mask out forests, and the sea for the curing maps.



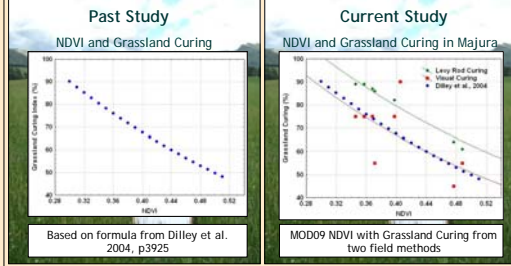
NDVI - MOD09 and MOD13



MOD09 and MOD13 derived NDVI in Majura from July 2005 to June 2006.



NDVI and Grassland Curing



A similar relationship was found in Northern Australia, however, the exponential curve found only in sites of **red** soils, with a linear relationship for **black** soils (Allan et al., 2003)