ASSESSMENT OF GRASSLAND CURING USING FIELD SPECTROSCOPY AND SATELLITE IMAGERY

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INTRODUCTION

Certain curing (senescence) characteristics determine the vulnerability of grass to propagate a fire. Using field spectroscopy and satellite imagery at a grassland site in Victoria, this research explores which regions of the visible, near-infrared (NIR) and mid-infrared (MIR) spectrum best correlate with curing.

METHODS

Curing sampling: measured the percentage of dead grass using a Levy Rod approach [1].
Satellite data: generated from a MODIS (MODerate resolution Imaging Spectroradiometer) product: MOD09A1-Surface Reflectance (8 day composite, 500 m resolution).
Spectroscopy: An ASD (Analytical Spectral Devices) Spectroradiometer (350 - 2500 nm) with an 8° lens was mounted on a tripod (height = 108 cm, field of view = 30 cm diameter).

RESULTS AND DISCUSSION

Each curve in Figure 1 represents an ASD-derived reflectance spectrum on a particular day, and is coloured according to the curing value on that day. The spectra in Figure 2 were generated from MODIS bands 1 to 7, again coloured according to curing values. As shown in both figures, spectral signatures of green vegetation (low curing) are characterised by low reflectance in the visible and MIR (controlled by pigment and water absorption features) and high reflectance in the NIR (dominated by cell structure) [3, 4, 6]. As grasses cure, however, the reflectance tends to increase in the visible and MIR, and decrease in the NIR.

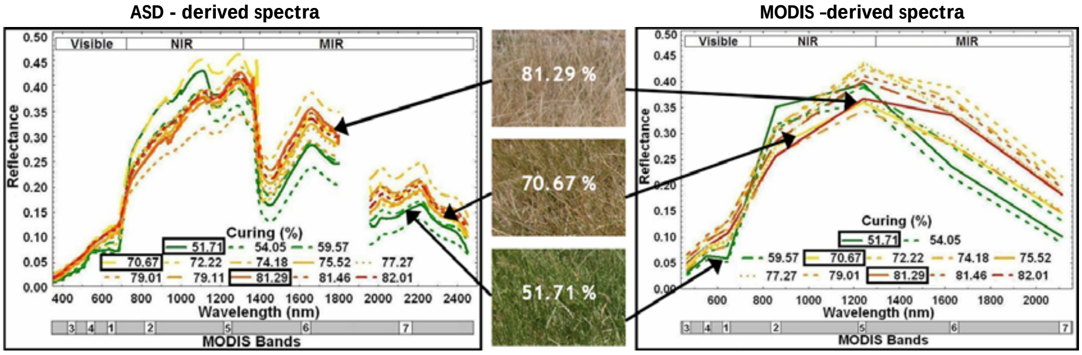

Fig.1 ASD spectra of grassland at Caldermeade (30-11-07 to 22-01-08). Areas with gross atmospheric scattering were removed, resulting in a gap between 1800 and 1960 nm.

Fig.2 MODIS spectra of grassland at Caldermeade (30-11-07 to 19-02-08), generated from MOD09's seven bands.

ASD and MODIS bands reflectance against curing

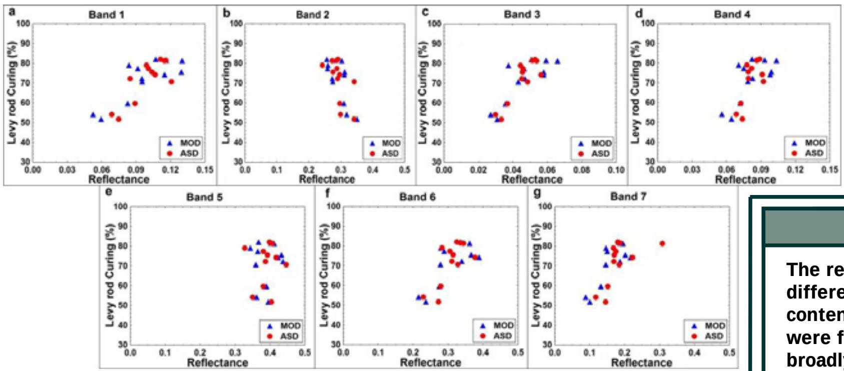

Fig.3 Relationship between curing (%) and reflectance in each MODIS Band (derived from MOD09 "MOD" and from ASD field spectroscopy "ASD") at Caldermeade.

Figure 3 compares MODIS-band reflectances simulated from the ASD field spectra, and MOD09 reflectances, with curing. Bands 5 and 6 have been used, as indices in combination with Band 2, to estimate vegetation water content [3, 7], which generally varies with curing [1, 2, 5]. While Bands 2 and 6 respond to curing, the reason for lack of response of Band 5 remains uncertain. As expected, Bands 1 and 3 show a strong response to curing owing to chlorophyll content. Bands 4 and 7 also show a response.

SUMMARY

The reflectance spectra of grasslands at Caldermeade illustrated definite differences between green and cured grass due to the effects of water content and pigment absorption features. *In situ* observations of curing were found to correlate well with MODIS spectral responses and be broadly representative of the monitored site. The relationships between curing, MODIS data, and ASD field spectroscopy will help identify which bands are most useful for curing assessment, as part of ongoing CRC research to develop more reliable satellite curing assessment techniques that are applicable to grasslands across Australia and New Zealand.

REFERENCES

1. Anderson, S. A. J., Anderson, W. R., Hines, F. and Fountain, A. (2005) Determination of field sampling methods for the assessment of curing levels in grasslands. Bushfire CRC Report (unpublished).
2. Barber, J., 1990. Monitoring the Curing of Grassland Fire Fuels in Victoria, Australia with sensors in satellites and aircraft. A Country Fire Authority study in Remote Sensing. CFA, Melbourne.
3. Cheng, Y., Zarco-Tejada, P. J., Riano, D., Rueda, C. A. and Ustin, S. L. (2006) Estimating vegetation water content with hyperspectral data for different canopy scenarios: Relationships between AVIRIS and MODIS indexes. *Remote Sensing of Environment*, 105, 354-366.
4. Daughtry, C. S. T. and Biehl, L. L. (1985) Changes in spectral properties of detached birch leaves. *Remote Sensing of Environment*, 17, 281-289.
5. Dilley, A., Millie, S., O'Brien, D. and Edwards, M. (2004) The Relation between Normalized Difference Vegetation Index and Vegetation Moisture Content at three grassland locations in Victoria, Australia. *International Journal of Remote Sensing*, 25, 3913-3928.
6. Knipling, E. B. (1970) Physical and physiological basis for the reflectance of visible and near-infrared radiation from vegetation. *Remote Sensing of Environment*, 1, 155-159.
7. Zarco-Tejada, P., Rueda, C. and Ustin, S. (2003) Water Content estimation in vegetation with MODIS reflectance data and model inversion methods. *Remote Sensing of Environment*, 85, 109-124.

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