Development of Satellite Vegetation Indices to Assess Grassland Curing Across Australia and New Zealand

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AIM

Using AVHRR and MODIS remote sensing, the aim of this project is to develop improved methods and identify the most appropriate vegetation indices for the assessment and prediction of grassland curing, across Australia and New Zealand.

INTRODUCTION

Grasslands cover 75% of Australia (Cheney and Sullivan 1997) (figure 1) and contribute to 70% of vegetation cover in New Zealand (Fogarty and Pearce 1995). Depending on the stage of a grasses life cycle, certain characteristics (water content and curing %) determine the vulnerability of grass to ignite / spread a fire (Barber 1992).

Vegetation Types across Australia

Fig.1 Carnahan Classification for vegetation around Australia. (Source: Hill et al., 2006, p 498)

Reflectance Spectra of Grass

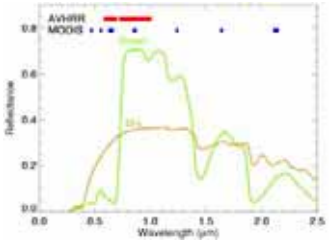

Fig.4 AVHRR and MODIS bands with the reflectance spectra of green and dry grass. Source: Grant, 2006

WATER CONTENT

Water Content is one of the two most important factors that influence the spread of a fire , the other being wind speed (Cheney and Sullivan 1997). As vegetation loses its moisture (figure 4) and the chlorophyll content is reduced, the visible (0.4 to 0.7 µm) reflectance increases, meanwhile the near infrared (0.7-2.5 µm) reflectance decreases (Paltridge and Barber 1988).

Grassland Curing

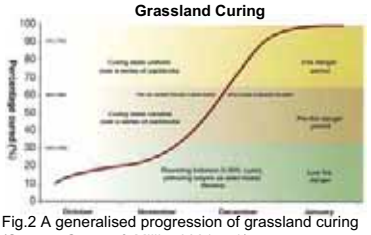

Fig.2 A generalised progression of grassland curing (Source: Garvey & Millie, 2001, p 3)

CURING

Grassland Curing is defined as the progressive senescence and drying out of a grass after flowering (annual) or in response to drought (perennial), and the curing state is the fraction of dead material in the grass sward (Cheney and Sullivan 1997) (figure 2). It is important to assess the curing state of grasses to predict fire danger and to assist in fire management.

METHODS

The use of vegetation indices will depend on which sensor is being used as these indices apply to certain wavelengths, as shown in figure 4. AVHRR, was used for the satellite curing index development in the 1980s across southeastern Australia and is still used for operations today. MODIS will provide more accurate data for future measurements with its 36 bands.

Possible indices used by AVHRR and MODIS are:

- Normalised Difference Vegetation Index (figure 3)
- Enhanced Vegetation Index
- Soil Adjusted Vegetation Index
- Normalised Difference Water Index

VEGETATION INDICES

Vegetation Indices tell us how densely or sparsely vegetated a region is, and how much sunlight (available for photosynthesis) is absorbed by vegetation (Campbell 2002). The Normalised Difference Vegetation Index (figure 3) for example is used to analyse changes in global vegetation (Kaufman and Tanre 1992).

NDVI Across Australia

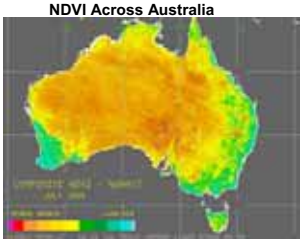

Fig.3 Maximum NDVI values in July 2005. Source: Bureau of Meteorology, 2006.

QUESTIONS

- How may satellite measurements, in several spectral bands, be best combined to quantitatively estimate the degree of grassland curing?
- How do factors such as grassland type, soil type, topography and amount of tree cover influence the algorithm?
- What is the accuracy of the satellite curing estimates?
- Do very cloudy regions/seasons require a modification to the algorithm to accommodate less frequent satellite views?

CONCLUSIONS

Approaches from literature, and an understanding of their limitations, will guide the development of a satellite – based method for curing assessment that is robust and validated across Australia and New Zealand. Methods will vary regionally due to climatic and topographic variability, and variability in grassland type.

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