STANDARDISED SPECTRA (0.4-2.5μm) AND ASSOCIATED METADATA:AN EXAMPLE FROM NORTHERN TROPICAL AUSTRALIA.

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1. INTRODUCTION

Ground or laboratory-based spectral measurements made using a portable spectrometer are required for many applications, including the determination of signature separation and remote sensing feasibility studies and for correlation with a remote sensing overpass. Spectral reflectance, radiance or irradiance measurements are meaningless without metadata describing what was measured and how the measurement was obtained. There are no national standards on *in situ* reflectance measurement or management of such data in terrestrial applications. It is quite probable that some spectral campaigns are undertaken without metadata being captured. In these instances, the effort expended in spectral collection may only be applicable to a single point and time and not transferable to another researcher. This may be due to the following factors: few samples are acquired, accurate metadata are not recorded, the data are not stored in a manner that is easily retrievable or with appropriate ancillary data for quality control, the method of data collection is not described and the environmental data may be spatially and temporally dependant. In order to gain "reference" spectra of objects of interest, the sample size and temporal collection must be appropriate and metadata describing what was measured and how the measurements were taken must accompany the spectral data. Importantly, spectral and metadata information must be linked and organised. Such reference spectra can then be used to their full extent, in applications beyond their original intent and in data sharing with other researchers.

The Supervising Scientist Division (SSD) of the Department of the Environment, Water, Heritage and the Arts (DEWHA), Australia, investigate the use of remote sensing data for potential to improve the extent of information collected for the management of both operating and rehabilitated minesites. To use remotely sensed data for routine monitoring applications, comprehensive information on the spectral separability of land cover discrimination at different scales is required. This information will facilitate the selection of suitable sensors and processing methodologies to be applied to the mine environment. SSD have developed standards for collecting field reflectance spectra and these have been reported [1, 2 & 3]. This paper describes the development of SSDs Spectral Database that is used to reference, categorise and manage our spectral data and metadata so that suitable data can be queried and analysed.

2. STANDARDISED SPECTRA AND METADATA

A spectral database of land cover endmembers pertinent to remote sensing for mine site assessment is being developed, and these endmembers are appropriate to a range of applications outside the mine environment (e.g. natural resource management, pastoral activities, bushfire impacts). A field spectrometer that measures reflectance continuously across 350-2500 nm at full-width-half-maximum (FWHM) resolution of 3 nm for the region 350-1000 nm and 10 nm for the region 1000 – 2500nm is used to collect spectra. Measurements are made in the field for feasibility studies and for *in situ* correlation with an overpass of remotely sensed data. *In situ* spectral data of interest include measurements of both native and introduced vegetation species, mineral assemblages and soils and leaf litter that represent both the mining surface and the “reference” surrounding country. Spectra representing the operating mining environment, such as stockpile material and infrastructure are also measured. At times of image acquisition, spectra relating to the calibration and validation of hyperspectral data are made by measuring atmospheric conditions with a cosine receptor or the spectral response of pseudo-invariant features. Regular laboratory measurements are made for accuracy assessment of both the spectrometer itself (Mylar and Hg/Ar spectra) and the standard panels used to obtain the reflectance factor. Measurements of soils and minerals are also often made in both the controlled laboratory environment and in the field.

For every cover of interest in the field, a solar irradiance spectrum, white reference spectrum and set of cover spectra are made. Three replicates (of 25 averages each) are used to indicate the reflectance of the cover of interest. This totals a minimum of 5 averaged spectra relating to the measurement of each cover type. The same number of samples is obtained for covers of interest that are measured in the laboratory (such as dehydrated soils) except that the solar irradiance spectrum is absent. Accompanying each set of spectral readings for a cover of interest is a set of measured and observed metadata. Metadata descriptions are standardised and include site and target characteristics, environmental and illumination conditions, measurement information and photographic records. Photographic records of the sky conditions and the state of the ground target at the time of spectral measurements are made at each site of spectral sampling and include scaled setup, eastern and western sky and nadir photographs. For temporal sampling sites, photos are taken from the same location enabling the viewer to compare the target with similar backgrounds so that different backdrops do not distract the viewer. Spectra of different cover types are therefore collected at different temporal scales and environmental conditions. All spectra have an associated white reference spectrum and field spectra have an associated solar irradiance spectrum. These spectra need to be cross referenced. The metadata need to be assigned a spectral record and linked to the photographic data.

3. DATABASE STRUCTURE

A database was designed to manage the thousands of spectral entries and associated metatadata. The database structure has been custom designed to maximise cross referencing between spectra, photos and metadata. Some spectral libraries have been developed for a specific purpose [e.g. 4] and others for general use [e.g. 5]. SSD required a system to account for and link the spectral and metadata standards implemented. A SQL server is used as a data warehouse to store all information. The spectra and photos are stored as binary files within the database. The metadata table contains information about the conditions at the time spectra and photos were taken. Metadata include a unique code (site and date), date of spectral measurement, atmospheric conditions (smoke, haze, temperature, humidity, air pressure, wind direction, wind speed and description), cloud level and cover, probe height (from ground), plant height (from ground level) and ground description (by cover and phenology). Searches can be performed on the fields and individual records displayed. The structure allows the user to easily query information. Selected spectra can be viewed and overlaid to give a visual comparison.

Accurate metadata is required during the data analysis stage to ensure that environmental conditions (such as solar azimuth) are not influencing the spectral response, particularly for temporal spectral measurements. Photographic records help to interpret and determine the data quality for temporal data by supporting quantitative and qualitative measurements of the hemispheric component. Once all suspect spectra have been filtered out analysis can commence on the high integrity data. There are a number of spectral analysis management systems available online, including SAMS [6], SPECCHIO [7 & 8], SPECtrum Processing Routines (SPECPR) [9 & 10] and SpectraProc [11]. SSD also have expertise in computing language and interactive environments for algorithm development, data visualization, data analysis, and numeric computation. There are a number of toolboxes available including project specific signal processing techniques. These may be tested in parallel to benchmark any custom methods produced by this project.

4. CONCLUSION

Spectral data and metadata of ground covers have been measured and collated to make recommendations for acquisition of appropriate remotely sensed data. To maximise the usefulness of the thousands of spectral entries measured, and account for any extraneous variation in spectral measurement, a system was developed to organise and retrieve spectral and metadata records in SSDs Spectral Database. Spectral data include temporal field measurements from homogenous vegetation plots, field measurements of mineral and mineral assemblages, laboratory prepared and measured soil samples and field and laboratory measurements of standard panels.

Metadata descriptions are standardised and include site and target characteristics, environmental and illumination conditions, measurement information and photographic records. The organisation of such data makes these spectra suitable for data sharing.

5. REFERENCES

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