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MAPPING THE WETLAND VEGETATION COMMUNITIES OF THE AUSTRALIAN GREAT ARTESIAN BASIN SPRINGS USING SAM, MTMF AND SPECTRALLY SEGMENTED PCA HYPERSPECTRAL ANALYSES

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Abstract. The Australian Great Artesian Basin (GAB) supports a unique and diverse range of groundwater dependent wetland ecosystems termed GAB springs. In recent decades the ecological sustainability of the springs has become uncertain as demands on this iconic groundwater resource increase. The impacts of existing water extractions for mining and pastoral activities are unknown. This situation is compounded by the likelihood of future increasing demand for extractions.

Hyperspectral remote sensing provides the necessary spectral and spatial detail to discriminate wetland vegetation communities. Therefore the objectives of this paper are to discriminate the spatial extent and distribution of key spring wetland vegetation communities associated with the GAB springs evaluating three hyperspectral techniques: Spectral Angle Mapper (SAM), Mixture Tuned Matched Filtering (MTMF) and Spectrally Segmented PCA. In addition, to determine if the hyperspectral techniques developed can be applied at a number of sites representative of the range of spring formations and geomorphic settings and at two temporal intervals.

Two epochs of HyMap airborne hyperspectral imagery were captured for this research in March 2009 and April 2011 at a number of sites representative of the floristic and geomorphic diversity of GAB spring groups/complexes within South Australia. Colour digital aerial photography at 30 cm GSD was acquired concurrently with the HyMap imagery. The image acquisition coincided with a field campaign of spectroradiometry measurements and a botanical survey.

To identify key wavebands which have the greatest capability to discriminate vegetation communities of the GAB springs and surrounding area three hyperspectral data reduction techniques were employed: (i) Spectrally Segmented PCA (SSPCA); (ii) the Minimum Noise Transform (MNF); and (iii) the Pixel Purity Index (PPI). SSPCA was applied to NDVI-masked vegetation portions of the HyMap imagery with wavelength regions spectrally segmented for the VIS-NIR (450 – 1,350 nm), SWIR 1 (1,400 – 1,800 nm) and SWIR 2 (1,950 – 2,480 nm). The resulting pure endmember image pixels of the vegetation communities identified were used as target spectra for input into the SAM and MTMF algorithms.

Spring wetland vegetation communities successfully discriminated include low lying reeds and sedges along spring tails (*Baumea* spp. and *Cyperus* spp.), dense homogenous stands of *Phragmites australis* reeds, and sporadic patches of salt couch grass (*Sparabolus* spp.).

Our results indicate that a combination of hyperspectral remote sensing techniques which reduce superfluous wavebands providing a targeted spectral matching approach are capable of discriminating and mapping key vegetation communities of the GAB springs. This approach provides reliable baseline mapping of the GAB spring wetland vegetation communities, with repeatability over space and time. In addition it has the capability to determine the sensitivity of spring wetland vegetation extent, distribution and diversity, to associated changes in spring flow rates due to water extractions. This approach will ultimately inform water allocation plan management policies.

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