Estimating peat moisture content using simulated HyMap reflectance

Amer Al-Roichdi[1], Julia McMorrow, Martin Evans

Upland Environment Research Unit (UpERU), Geography, School of Environment and Development, University of Manchester, Manchester M13 9PL, UK
[1] Correponding author; amer.al-roichdi@student.manchester.ac.uk

POSTER ABSTRACT

Earlier results on HyMap data published in the SAR and Hyperspectral Airborne Campaign (SHAC) report show that there was no relationship between HyMap reflectance and peat moisture content, due to samples size and a limited range of decomposition. The experiment reported here explores the effect of gravimetric moisture content of peat on simulated HyMap spectra. The spectra were simulated from an Analytical Spectra Devices (ASD) spectro-radiometer used in the laboratory in contect probe mode. Thirty-four samples were collected from sites with different physical and chemical composition. Samples were wetted to saturation and spectra recorded with the ASD. They were then oven dried at 25 ºC for 10 minutes and spectra re-recorded. This was repeated at varying degree of dryness until the samples were totally dry. Around 22 spectra for each sample were produced at different moisture content, making a total of 748 spectra, which were simulated to match the band passes of the SHAC HyMap data.

The results show that the relationship between peat moisture and spectra reflectance is nearly linear in the SWIR and nonlinear (quadratic) in the NIR. Moisture was, therefore, transformed by squaring to linearize the relationship. Inverse regression modeling was applied on 60% of the samples, with the other 40% were for cross validation. Bands 95 and 66 were excluded because of the degree of noise at these water absorptions in the actual HyMap spectra. Regression models were produced for single band and continuum removed reflectance (depth below continuum). The regression using reflectance shows that band 98 is an excellent predictor of peat moisture, with R^2 0.931 and standard error (SE) 1.7%. Validation of this model gives R^2 of cross-validation (CV) 0.92 and SE of cross-validation (SECV) 0.018. For all samples taken together, spectral reflectance was insensitive to moisture contents above 65%, and below 40% the effect of humification also became significant, producing scatter in the moisture-reflectance relationship. For washed (redeposited) and poorly humified peats, moisture content was predicted even for very wet samples, unlike intermediate and well humified peat. Results from continuum removal regression for all samples show that the depth beneath the continuum at band 70 was the best predictor ($R^2$of CV 0.841 and SECV 0.94%). However, it is sensitive to washed peat; by excluding these samples R^2 was improved to 0.881 and SE 0.97.

The overall results suggest that reflectance in the SWIR is more sensitive than NIR to moisture change and that single reflectance modeling is more robust than depth beneath the continuum.

On-going work is developing regression models using the derivatives of reflectance and moisture-relative reflectance (normalized by the driest sample). The models use indices which characterize the shape of water absorption features, such as asymmetry and gradient of the shoulders and gradient between every pair of bands (paired-band slope).