EFFECTS OF WATER DEPTH AND TURBIDITY ON SPECTRAL SIGNATURE OF SUBMERGED AQUATIC VEGETATION

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Abstract: Remote sensing of terrestrial vegetation has been successful thanks to the unique spectral characteristics of green vegetation, low reflectance in red and high reflectance in Near-InfraRed (NIR). These spectral characteristics were used to develop vegetation indices, including Normalized Difference Vegetation Index (NDVI). However, the NIR absorption by water and light scattering from suspended particles reduces the practical application of such indices in Submerged Aquatic Vegetation (SAV) studies. We experimentally tested if NDVI can be used to depict SAV and to better understand the effects of water depth and turbidity on remote detection of SAV. A 100-gallon-outdoor tank was lined with black pond liners; SAV shoots were mounted on the bottom, and filled with water up to 0.5 m. We used a GER 1500 spectroradiometer to collect spectral data over the tank at every 1 cm depth change while water was constantly siphoned out. The measured upwelling radiance was converted to % reflectance; and we integrated the hyperspectral reflectance to match the Red and NIR bands of three satellite sensors: Landsat 7 ETM, SPOT 5 HRG, and ASTER. NDVI values ranged 0.6-0.65 when the SAV canopy was at the water level, then they decreased linearly (slope of 0.013 NDVI/meter) with water depth increases in clear water. The values were lower (<0.35) in turbid water even in shallow depth (<10cm). The NIR region that appears as a high plateau in terrestrial plants became two peaks at approximately 710-720 nm and 810-820 nm in the submerged plants. We are currently testing if incorporation of these unique NIR reflectance peaks of submerged plants would improve the use of hyperspectral aerial photographs in locating and estimating aerial covers of seagrass beds. The covariance among the spectral reflectance at varying depths was studied in order to find the three key wave bands. Airborne data were obtained by the AISA Eagle hyperspectral sensor in October 2003 over Grand Bay National Estuarine Research Reserve, Mississippi. Only the three AISA bands whose centers were closest to the three key wavelength regions (561nm, 710nm, and 819 nm) were used in SAM (Spectral Angle Mapping) classification. The classified image was overlaid with field SAV survey data. Compared to the original 20-band image, use of the NIR bands made chlorophyll-containing objects, both SAV beds and areas with high phytoplankton, more distinguishable. Although the shallow areas near the shore were correctly classified as SAV, the overall accuracy for the SAV class was less than 20 percent when compared with our field transect SAV distribution data due to varying depth and high-suspended particles.

Keywords: Vegetation Index, hyperspectral, SAV, water depth

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