DEVELOPMENT OF WATER CORRECTION ALGORITHM FOR UNDERWATER VEGETATION SIGNALS

Marvin Washington, Hyun J. Cho and D. Lu

Department of Biology, Jackson State University, Jackson, MS 39217, USA

Abstract: The unique spectral characteristics of green vegetation, low reflectance in red and high reflectance in Near-Infrared (NIR), have been used to develop vegetation indices, such as Normalized Difference Vegetation Index (NDVI). Our preliminary studies suggest that NDVI was not a useful indicator for submerged aquatic vegetation (SAV), even in clear water, due to energy absorption by water in the NIR region. In order to improve the use of the vegetation indices, we modeled the depth-induced water absorption and scattering through a controlled indoor experiment. We used a GER 1500 spectroradiometer to collect spectral data over an experimental water tank (70cm tall, 50cm wide) that was deployed with a black panel or a white panel at a time; the panels were cut to fit the bottom of the tank. Our assumptions were: (1) the black bottom panel absorbs 100% incoming light; (2) the white bottom panel reflects 100% incoming light; and (3) the water volume scattering and absorption remains the same for the two conditions (black and white bottoms) at a given depth. The measured upwelling radiance was converted to % reflectance. The overlying water significantly affected the vegetation signal. In an attempt to account for this, we developed correctional algorithms for water scattering and absorption using the reflectance data. After finding the contribution of these features, we were able to remove the water effects from the measured data. The SAV reflectance that was corrected using the algorithm produced a spectral signature more closely resembling those of terrestrial vegetation. The application of the algorithm significantly improved the vegetation signals, especially in the NIR region. Our results suggest the conventional NDVI: (1) is not a good indicator for submerged plants even at shallow waters (0.3 m); and (2) the index values can significantly improve once the water effects are modeled and removed. We applied the correction algorithm to image data. We used an aerial hyperspectral image taken over Corpus Christi, TX in July 2008. We applied the correction algorithm on the reflectance pixel values. Then we converted the results back into digital values. The spectral profile of the pixels with seagrass beds of the image did change to restore the higher NIR reflectance.

Keywords: SAV, reflectance, vegetation indices, absorption, volume scattering