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Band Characterization and Development of Hyperspectral Indices for Retrieving Chlorophyll Content

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Abstract : Quantitative estimates of foliar biochemicals, namely chlorophyll content (CC), serve as key information for the assessment of plant productivity, stress, and the availability of nutrients. This also plays a critical role in predicting the dynamic response of any vegetation to altering climate conditions. The advent of hyperspectral data with an enhanced number of available wavelengths has increased the possibility of acquiring improved information on CC. Retrieval of CC is extensively carried through well known spectral indices derived from hyperspectral data. In the present study, an attempt is made to develop hyperspectral indices by identifying optimum bands for CC estimation in Butea monosperma (Lam.) Taub growing in forests of Shoolpaneshwar Wildlife Sanctuary, Narmada district, Gujarat State, India. 196 narrow bands of EO-1 Hyperion images were screened, and the best optimum wavelength from blue, green, red, and near infrared (NIR) regions were identified based on the coefficient of determination (R^2) between band reflectance and laboratory estimated CC. The identified optimum wavelengths were then employed for developing 12 hyperspectral indices. These spectral index values and CC values were then correlated to investigate the relation between laboratory measured CC and spectral indices. Band 15 of blue range and Band 22 of green range, Band 40 of the red region, and Band 79 of NIR region were found to be optimum bands for estimating CC. The optimum band based combinations on hyperspectral data proved to be the most effective indices for quantifying Butea CC with NDVI and TVI identified as the best ($R^2 > 0.7$, $p < 0.01$). The study demonstrated the significance of band characterization in the development of the best hyperspectral indices for the chlorophyll estimation, which can aid in monitoring the vitality of forests.

Keywords : band, characterization, chlorophyll, hyperspectral, indices
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