COMPARISON OF VEGETATION INDICES FOR PRACTICABLE HOMOLOGY

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ABSTRACT

Vegetation indices are widely used to assess quantitatively the biophysical characteristics of vegetation from remote sensing measurements. Different indices have their own advantages in retrieving vegetation information. It is very difficult to precisely attribute any vegetation index to any particular vegetation biophysical parameter. This study examines the correlations among different vegetation indices derived from a set of mustard, gram and wheat fields at three different phenological growth stages. The results are presented as correlation matrices along with correlation scatter plots. Homologous (equi-magnitude) vegetation information is represented by NDVI, PVI and AtRVI for wheat crop with leaf area index less than 1.

Introduction

The specific reflectance, absorption and emission of solar radiation by objects on the surface of Earth form the basis of multi spectral remote sensing. The visible and near infrared spectral range; due to advantages such as - concentrates the largest portion of solar energy, covers the biologically important spectra, requires relatively simple technical devices and shows significant sensitivity to plant parameters variations, are widely used in soil and vegetation monitoring. Spectrometric studies rests on the fact that the reflected energy by an object contains information about its biophysical properties.

Vegetation Indices (VIs) are mathematical combinations of two or more spectral reflectances

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and are expressed as ratios, weighted sums, normalized differences, etc. VIs have been used to quantify vegetation biophysical parameters (Elvidge and Chen, 1995; Chen and Chilar, 1995). These indices have been widely used to monitor crops (Ayyangar et al., 1980), estimate crop acreage (Dadhwal et al., 2002; Jaishanker et al., 2001), crop condition assessment (Rao and Sugimura, 1987; Kogan, 2001; Sehgal et al., 2001), crop yield modelling (Vyas et al., 1999; Oza et al., 2001; Jaishanker et al., 2001b; Dadhwal et al., 2003), derive biomass (Venkateshwarulu et al., 1976) and Leaf Area Index (LAI) (Jaishanker et al., 2003; Hogg, 2004). Statistical methods used for data processing, includes correlation analyses.

There is very little quantitative understanding of the biophysical parameter actually represented by any VI. Disagreements exist as to whether the appropriate interpretation of the ratio indices should be based on the angle between a point and the x-axis, or the perpendicular distance from the soil line. The authors attempt to compare the relation between Ratio Vegetation Index (RVI), Normalised Difference Vegetation Index (NDVI), Arctangent of RVI (AtRVI), Perpendicular Vegetation Index (PVI) and Soil Adjusted Vegetation Index 2 (SAVI2) to evaluate the homology or correspondence in the vegetation information conveyed by them.

**Vegetation Indices**

A number of indices are available for detection of vegetation from remote sensing (Jackson, 1983; Elvidge and Chen, 1995). The general principles behind the construction of vegetation indices (VIs) is that they should be sensitive to foliage density and structure, but insensitive to other environmental variables such as soil background, atmospheric attenuation, and solar angle (Schutt et al., 1984; Gilabert et al., 1996). Although many of the VIs proposed over the past 30 years have a normalizing effect with respect to atmospheric noise, studies have shown that they are sensitive to a variety of external factors such as background reflectance, canopy architecture, and solar elevation.

**Broadband Vegetation Indices**

Numerous vegetation indices based on canopy spectral reflectance have been developed during the past three decades. Generally, these indices have been developed in an attempt to enhance their sensitivity to key bio-physical parameters such as Green Leaf Area Index (GLAI) and Absorbed Photosynthetically-Active Radiation (APAR), and biomass, while minimizing their sensitivity to external factors such as soil spectral properties, view/illumination geometry and atmospheric composition, which is usually regarded as noise.

The most common of these classic vegetation indices are based on the Red and the NIR bands, because vegetation exhibits unique reflectance properties in these bands. Depending upon their nature, the early vegetation indices are generally divided into ratio indices and orthogonal indices. Whereas ratio indices are calculated independent of soil reflectance properties, the orthogonal indices refer to a base line specific to the soil background. This soil line is normally defined by the coefficient $a$ and constant $b$, representing the slope and $y$-intercept respectively as determined by linear regression of the bare soil reflectance in the Red-NIR spectral space.

More recently, indices have emerged that can be considered hybrid versions of the classic ratio and orthogonal indices.

**Ratio Vegetation Indices**

The best-known classic vegetation indices are the Ratio Vegetation Index (RVI), Pearson and Miller (1972) and the Normalized Difference Vegetation Index (NDVI), Rouse et al. (1974), which are based on the reflectance in the Red and NIR part of the spectrum. RVI is related to the slope of the line,