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VEGETATION INDEX METHODS: A COMPARATIVE ANALYSIS OF NDVI, EVI AND SAVI

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Summary. *This study emphasizes the importance of monitoring and predicting plant functional traits for ecological and agricultural research, particularly in the context of climate change. Hyperspectral remote sensing is a key tool for studying vegetation health and ecosystem dynamics due to its efficiency and wide coverage. Common modeling methods include vegetation indices, partial least squares regression, and process-based models. This paper compares the advantages and disadvantages of three vegetation indices: NDVI, EVI, and SAVI.*

The most commonly used vegetation index methods include the Normalized Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI), Soil Adjusted Vegetation Index (SAVI) and many other methods [1], which are used to compare and analyze the performance differences of various vegetation indices in vegetation monitoring and biomass estimation. They estimate vegetation coverage by analyzing the reflectivity differences between different bands [2]. Plants have a strong reflectivity to near-infrared light and a weak reflectivity to red light, so the reflectivity difference between red light and near-infrared light can reflect the growth and health of vegetation [3].

NDVI is an index analysis method that can reflect the background influence of plant canopy, such as soil, wet surface, snow, dead leaves and vegetation density, and is closely related to vegetation coverage. The formula of NDVI is as below.

$$NDVI = \frac{(NIR\text{-}Red)}{(NIR+Red)} \tag{1}$$

Where NIR is the reflectance of the near-infrared band, and Red is the reflectance of the red-light band.

The NDVI value range is usually between -1 and 1. Usually, a value greater than 0.2 indicates the presence of vegetation, and a higher value indicates better vegetation health [4].

EVI, which is an improvement on NDVI. It can more effectively reduce the interference of atmospheric and soil background on vegetation index and is more suitable for monitoring high-density vegetation. The formula of EVI is as below.

$$EVI = G\times \frac{(NIR\text{-}Red)}{(NIR+C1\times Red\text{-}C2\times Blue+L)} \tag{2}$$

Where G, C1, C2, and L are empirical coefficients used to adjust soil and atmospheric interference. At the same time, the blue light band is added, which has a better atmospheric correction effect and is suitable for areas with high-density vegetation coverage.

SAVI, which adds a soil correction factor L to NDVI to reduce the interference of soil background on vegetation index, making it more suitable for analysis in areas with sparse vegetation. The formula of SAVI is as below.

$$SAVI=\frac{(NIR\text{-}Red)\times(1+L)}{(NIR+Red+L)} \tag{3}$$

Where the value range of L is usually between 0 and 1. When the vegetation coverage is high, the value of L is smaller, and when the vegetation is sparse, the value is larger [5].

The table 1 below shows a comparison of these methods.

Table 1 – Comparison of three common methods

Index	Advantage	Shortcoming	Applicable scenarios
NDVI	Simple calculation and wide application	Sensitive to soil background and atmospheric disturbance, high-density vegetation is easily saturated	Vegetation monitoring, change detection
EVI	Considers atmospheric and soil background, suitable for high-density vegetation	The calculation is complex and requires support from the blue light band	Detailed vegetation monitoring
SAVI	Reduce soil background interference, suitable for sparse vegetation	Parameter selection is complex and accuracy is limited	Low vegetation cover area

Therefore, various vegetation indices have their own advantages and disadvantages, and the appropriate method needs to be selected according to specific application requirements and regional characteristics.

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