DEVELOPING A NOVEL TOPOGRAPHY - ADJUSTED VEGETATION INDEX (TAVI) FOR RUGGED AREA

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1. ABSTRACT

Vegetation index, usually formed by utilizing spectral transformations of two or more wavebands, is an effective and simple radiometric measure of terrestrial vegetation activity, which plays an important role in quantifying green-leaf vegetation and monitoring major vegetation fluctuations and associated environmental effects, hence it is extremely significant for the remote sensing society and other related disciplines. Considerable attention has been devoted to exploiting various vegetable indexes and related applications in the past four decades (Jordan, 1969; Rouse et al., 1974; Huete, 1988; Kaufman et al., 1992; Huete, et al, 1994; Jiang, et al., 2008). Most vegetation indices have been developed to enhance vegetation properties and give reliable representations of photosynthetic activity and structural canopy variations, while some improved vegetation indexes are designed to provide more sensitive measurements of plant biophysical parameters and to reduce external noise interferences such as those caused by soil and atmosphere (Huete, 1988; Qi et al., 1994; Rondeaux et al., 1996; Gilabert et al.,2002; Kaufman et al.,1992; Gitelson et al.,1996; Gitelson et al., 2002). However, to our scope, few vegetable indexes have been developed to reduce topographic effects in rugged area.

This paper introduces a novel topography - adjusted vegetation index (TAVI) to achieve accurate vegetable information in rugged area. By characterizing the spectral difference of vegetation cover in the sunlit and shadowed mountain slopes with optical remote sensing data, the proposed method can effectively diminish the topographic effect, which provides a better vegetable index with much higher accuracy. The key of the proposed vegetable index is topographic adjusting coefficient ($f(\Delta)$), which has a three-step calculating routine that involves the integration of: (1) Classification. The shadowed and sunlit slopes are classified by the unsupervised-classification or supervised-classification method, e.g. ISODATA algorithm or maximum likelihood classifier. (2) Selection. Choose some adjacent pixels in

shadowed and sunlit slopes of the rugged area, and detect the uniformity and scope of vegetation canopy by field investigation, aerial survey or Google-earth data. (3) Optimization. Let $f(\Delta)$ vary from 0 to 1 by fixed stepwise and evaluate the TAVI mean values of uniform vegetation canopy between the shadowed and sunlit slopes. If the mean difference of TAVI values between the shadowed and sunlit slopes with uniform vegetation canopy reaches minimum, the optimized $f(\Delta)$ is determined.

To validate the performance of the proposed vegetable index, our experiments using the apparent reflectance data of Landsat TM images for the area in Fujian province of China were carried out. The experimental results show that the proposed algorithm can effectively reduce topographic effects caused by rugged terrain. The correlation coefficient between the TAVI and the solar incidence cosine, and the slope of linear regression equation between them are only around 0.01. For comparison, widely used vegetable indexes, such as the normalized difference vegetation index (NDVI) (Rouse et al., 1974), ratio vegetation index (RVI) (Jordan, 1969), soil-adjusted vegetation index (SAVI) (Huete, 1988), global environmental monitor index (GEMI)(Pinty, et al, 1992) and enhanced vegetation index (EVI)(Huete, et al, 1994) were also implemented with the same data. The experimental results demonstrate that our vegetable index has the advantage of resisting topographic effect, which can achieve better accuracies, especially in rugged area. Moreover, the proposed method still works well without the support of digital elevation model (DEM) data, which greatly extends its potentially applicable scope.

Some primary experiment results are displayed as follows (Fig. 1). It is clear that the proposed TAVI significantly resists the topographic effect. The detailed procedure and discussion will be presented in our full paper.

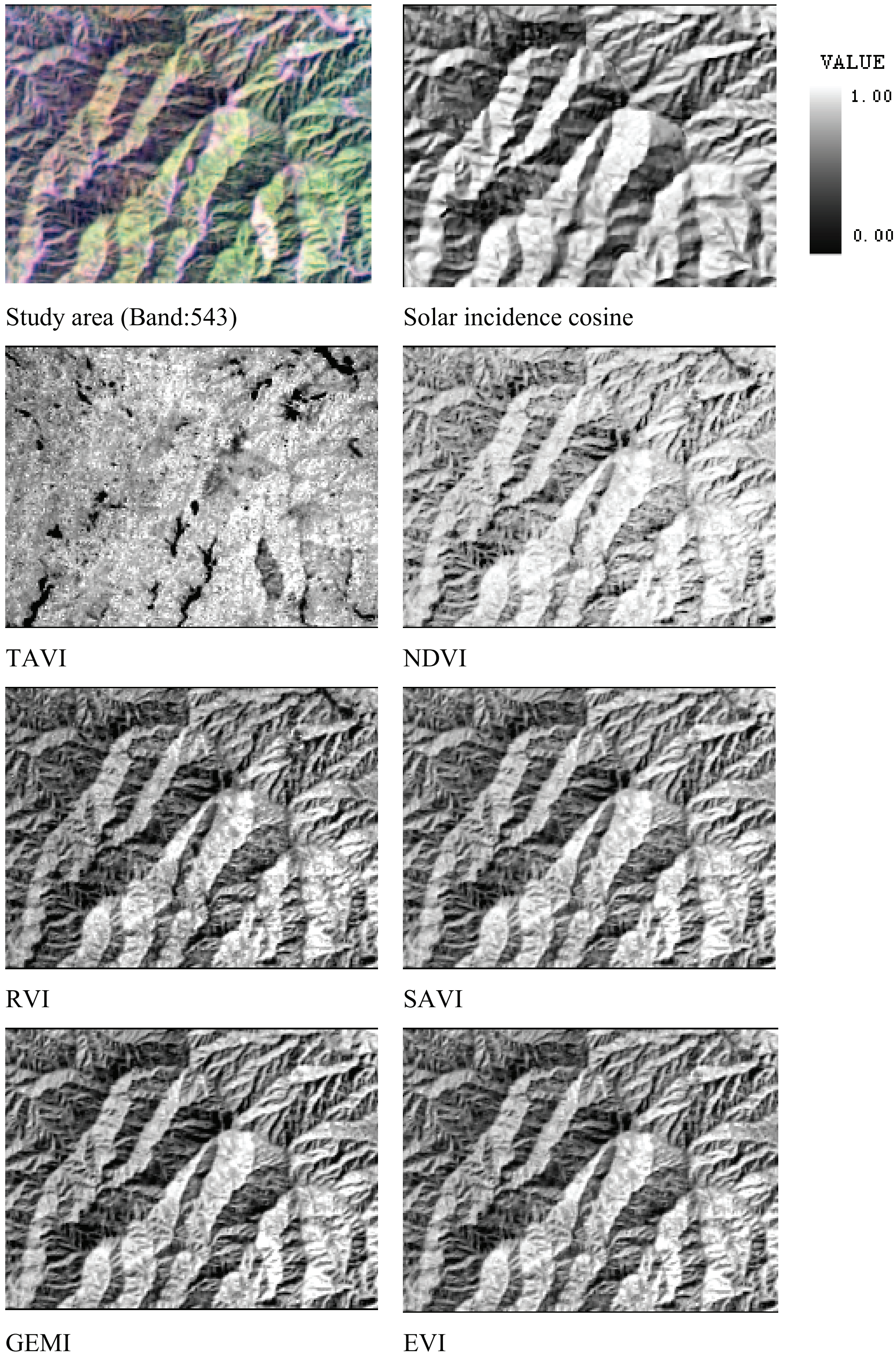

Fig. 1 The sample TM image (band: 543), solar incidence cosine and vegetation index gray scale images

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