SPECTRAL COMPATIBILITY ANALYSIS OF THE ENHANCED VEGETATION INDEX FOR LONG-TERM CONTINUITY ACROSS AVHRR, MODIS, AND VIIRS

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1. Introduction

Spectral vegetation indices are widely used in long-term studies of vegetation changes in relation to interannual climate variability and global warming. The enhanced vegetation index (EVI) is one of the vegetation indices included in Moderate Resolution Imaging Spectroradiometer (MODIS) standard vegetation index products (MOD13 and MYD13 series) and is also considered for one of the standard products for Visible Infrared Imager Radiometer Suite (VIIRS). The EVI was developed to optimize the vegetation signal with improved sensitivity in high biomass regions and improved vegetation monitoring through a de-coupling of the canopy background signal and a reduction in aerosol influences [1]:

$$\mathrm{EVI} = G \cdot \frac{\rho_{\mathrm{NIR}} - \rho_{\mathrm{red}}}{\rho_{\mathrm{NIR}} + C_1 \rho_{\mathrm{red}} - C_2 \rho_{\mathrm{blue}} + L} \quad , \qquad (1)$$

where ρ_{NIR}, ρ_{red}, and ρ_{blue} are the atmospherically corrected reflectance (totally or partially for molecular scattering, and water vapor and ozone absorptions) for the near-infrared (NIR), red, and blue spectral bands, *L* is the canopy background adjument factor that addresses nonlinear, differential NIR and red radiative transfer through a canopy, and *C*1 and *C*2 are the coefficients of the aerosol resistence term, which uses the blue band to correct for aerosol influences in the index. Recent studies have shown improved vegetation characterization capabilities with the EVI upon the conventional normalized difference vegetation index (NDVI), in particular, for the estimation of gross primary productivity (GPP) [e.g., 2].

There is significant interest in extending the EVI capability backward for the Advanced Very High Resolution Radiometer (AVHRR) sensor series to complement NDVI time series. One issue associated with deriving an EVI record from AVHRR is the fact that the AVHRR sensor series do not have a blue band, which is required for the EVI computation. Recently, a two-band EVI without a blue band, EVI2, has been developed to address the backward compatibility issue [3]:

$$\mathrm{EVI2} = G \cdot \frac{\rho_{\mathrm{NIR}} - \rho_{\mathrm{red}}}{\rho_{\mathrm{NIR}} + (C_1 - C_2/c) \cdot \rho_{\mathrm{red}} + L}, \quad (2)$$

where c is the slope for the relationship between red and blue reflectances. The EVI2 has been calibrated and its compatibility with the EVI has been demonstrated for MODIS.

In this study, we used airborne hyperspectral data and examined cross-sensor EVI/EVI2 relationships across MODIS, AVHRR, VIIRS, and VEGETATION with the objectives of deriving spectral transformation functions for the EVI/EVI2 across these sensors and of finding the optimum EVI coefficients for each sensor.

2. Methods

An airborne hyperspectral reflectance dataset acquired along a tropical forest-savanna transitional region in Brazil was used in this study [4]. The reflectance data were spectrally aggregated to simulate the red, NIR, and blue bandpasses of the MODIS, AVHRR, VIIRS, and VEGETATION sensors, from which the EVI (except for AVHRR) and EVI2 were computed. The compatibility of EVI/EVI2 across these sensors were evaluated by examining the trends observed in EVI or EVI2 differences among the sensor pairs. The EVI coefficients were varied, whose impacts were assessed by evaluating changes in the trends.

3. Conclusions

Cross-sensor EVI and EVI2 relationships varied among sensor pairs; however, they could be modeled reasonably well using the simple linear equation. Variability from the mean trends (or relationships) became smaller or larger as the EVI coefficients were varied. It was felt that the spectral bandpass difference and optimum EVI coefficient issues need to be addressed simultaneously for developing the spectral transformation functions for the EVI and EVI2 and a protocol should be developed to facilitate the work.

4. Bibliography

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