Inter-Sensor Calibration of Vegetation Indices for Monitoring and Continuity Studies of Ecosystem Variability

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ABSTRACT

Numerous satellite sensor systems useful in terrestrial Earth observation and monitoring have recently been launched and their derived products are increasingly being used in regional and global vegetation studies. The use of these multi-resolution sensors offer much opportunity for vegetation studies aimed at understanding the terrestrial carbon cycle, climate change, and land cover conversions. Spectral vegetation indices are one example of widely-used satellite-based products for mapping temporal and spatial variations in surface biophysical parameters. Vegetation index products from SeaWiFS, VEGETATION, MODIS, Landsat, and other sensors are now widely available for monitoring both seasonal and long-term ecosystem dynamics. However, data compatibility problems among the various satellite products due to differences in sensor characteristics as well as algorithms must first be addressed. In this paper we analyze the broadband reflectance and VI relationships among the various sensors with the use of airborne and spaceborne hyperspectral data sets as well as actual multi-sensor, satellite observations. We focus on the spectral and spatial issues (filter response function, point spread function, bandwidth, center wavelength) influencing the derived reflectance and vegetation index products. We explored and present the various issues involved in their synergistic use, including translation, data continuity, and scaling. The Hyperion and AVIRIS bandpass-convolved results indicate that inter-sensor VI relationships were neither linear nor unique and varied with land cover and surface composition. Thus, a VI value from one sensor can yield multiple values in a second sensor. Prior knowledge of ecosystem parameters, such as leaf area index and soil brightness are needed for translation. Multi-sensor comparisons with actual data from Landsat, EO-1, MODIS, AVHRR, and Terra are also presented.