Spectral index optimization for crop classification using different optical satellite sensors

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Abstract

An increasing number of satellite sensors improves the potentials for vegetation analysis and classification. However, the sensors which are appropriate for cropland monitoring are differently characterized regarding spatial, spectral and temporal resolution, each having advantages and disadvantages compared to each other.

Computation of vegetation indices is an established method to discriminate between different crop types. The computation of these indices differs according to the available spectral bands of a satellite sensor. Several indices, e.g. NDVI and SAVI, are formulated in a way that they can be computed for most of the available satellite sensors. Contrarily, for spectral discrimination between similar crop types other, more specific indices could lead to higher classification accuracies.

These sensor-specific indices can be found either by using field reflectance spectra or, more efficiently, by testing a huge number of band and weighting parameter combinations. The latter approach compares the capability in separating two target crops by computation of spectral similarity measures like Kolmogorov-Smirnov-Distance, eta-squared or accuracies of unsupervised classification approaches such as k-means.

In this study we calculated the optimized indices for spectral classification of winter wheat and winter barley for a combined time series consisting of SPOT, RapidEye and Landsat-8 data. The test site for this study covers 25 x 25km and is located approximately 30 km north of Halle (Saale). The optimization approach is performed using a small number of test fields (approximately 20 per class). The found optimized index is then calculated for the complete test site and the classification accuracy assessed and compared to the performance of standard vegetation indices. Further, the sensor performance can be accessed by comparison of results of similar acquisition dates but different sensors.

The results show, that optimized indices are better suited in separation of the target classes than NDVI, EVI etc. and that the spectral separability varies during the growing season as consequence of phenological differences between the crops. The sensor-specific differences in class separability are evaluated and discussed.