AUTOMATIC REMOTE SENSING METHODS FOR THE MONITORING OF AGRICULTURAL LANDSCAPE ELEMENTS IN THE CONTEXT OF IACS AND CROSS COMPLIANCE

An impulse on sensor transferability for an object-based image analysis

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Monitoring Duties on a European Level

The acquisition of spatial data for large-area monitoring duties within the Integrated Administration and Control System (IACS), dealing with European agricultural subsidies, is widely done by manual digitising. In order to achieve direct subsidy payments each farmer has to fulfill so-called Cross Compliances dealing amongst others with the conservation of special landscape elements located close to the agricultural reference parcels (Reg. (EC) 1782/2003). Geographic information systems are used to link each declared parcel to the appropriate landscape elements with their geographic coordinates, which have to be updated regularly by agricultural administrations to give the opportunity to analyse the spatial condition and temporal changes of agricultural landscapes. For these monitoring duties an object-based hierarchical classification of landscape elements is presented here. It aims at reducing the manual workload for the acquisition of the required spatial datasets and at supporting the IACS system with objective, transparent and standardised monitoring methods.

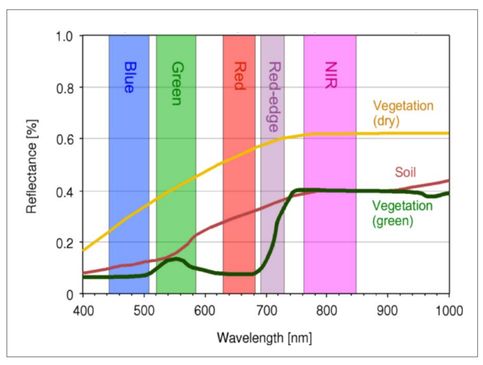

Fig. 1: Spectral bands of RapidEye (Jung-Rothenhaeusler et al. 2007, modified)

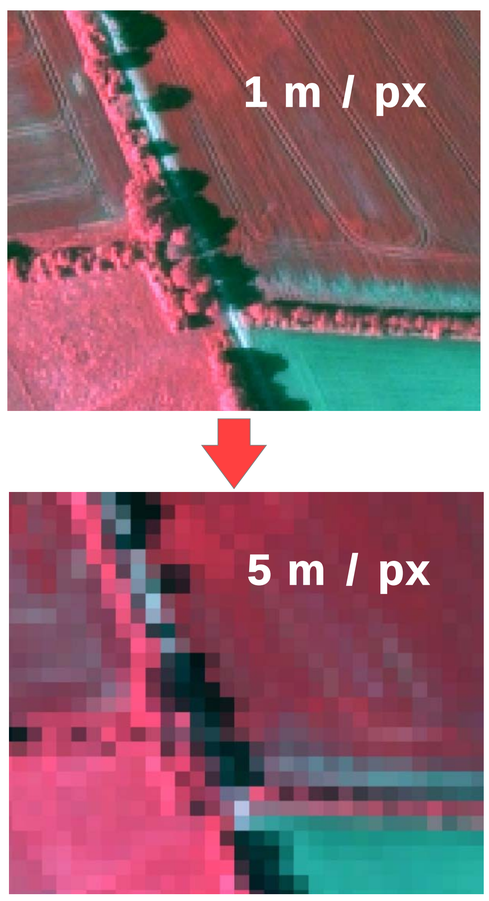

Fig. 2: Rescaling process of the IKONOS-data (Image data: MUNLV NRW 2008)

Simulated RapidEye-Data

RapidEye (RE) is a new system of five satellites with a 5-channel multispectral sensor, a geometrical resolution of 5 m per pixel and a temporal resolution of at most one daily image of every place on earth (RapidEye AG 2008). Capturing the high spectral variability of crops in the so called red edge band (fig. 1) from May to July, while other spectral bands like visible red or near infrared already reached their spectral local maxima or minima, RE shows a high significance on the vitality of vegetation. Therefore and because of its very high temporal resolution it is of special interest for remote sensing in agricultural monitoring. Due to the lack of real early summer images of RE (it started no more than in August 2008), RE images were simulated by rescaling IKONOS-images from 1 m per pixel to 5 m per pixel (fig. 2) in order to simulate the geometrical resolution of RE (not the spectral characteristics like the red edge band) and to figure out a first impression of its potentials for automatic landscape element extraction in the test area in North Rhine-Westphalia (Germany) (fig. 3 and 4).

Object-based classification of landscape elements

Wooden landscape elements like hedge- / tree-rows or groves are detected by an object-based hierarchical classification (fig. 5 and 6) (Völker & Müterthies 2008):

1. In the 1st step the test area is divided into **“agricultural”- (grey)** and “non-agricultural”-areas by GIS data from the agricultural administration.
2. In the 2nd step “non-agricultural”-areas are classified by spectral NDVI-information into “vegetated”- an **“non-vegetated”- (orange)** areas.
3. “Vegetation” is divided by spectral and textural information into the classes “wooden vegetation” and **“other vegetation” (light green)**.
4. The last classification step divides the “wooden vegetation”-areas into **“forests” (dark green)**, **“agricultural groves” (dark cyan)**, **“hedge- / tree-rows” (medium green)**, **“single trees/shrubs” (light cyan)** and **“wooden elements with no agricultural context” (red)** by geometrical and structural information.

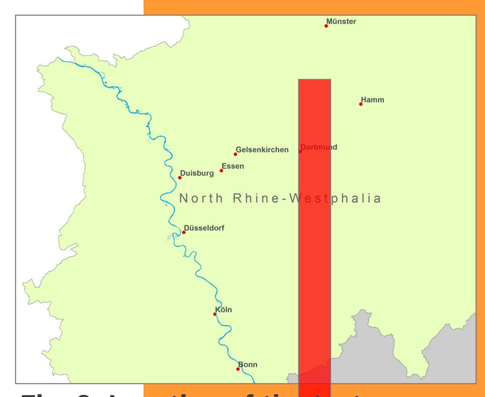

Fig. 3: Location of the test area

Fig. 4: The simulated RapidEye-data of the test area (Image data: MUNLV NRW 2008)

Fig. 5: Automatic result of the processed test area

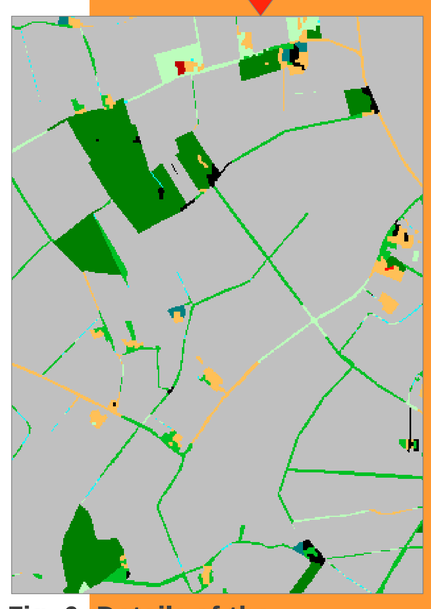

Fig. 6: Details of the automatic results

First Results and Perspectives

The low resolution of 5 m per pixels can lead to interrupted representations of linear elements (like hedge- / tree-rows) in the automatic results, but these interrupted parts should be sufficient to automatically verify the existence of a known element. Compact elements like agricultural groves are represented in the results in an even more adequate way. The automatic classification method (originally developed for colour-infrared-images) shows a high transferability on data with a lower resolution, because only slight modifications were necessary. Though the geometrical and thematic precision of very high resolutional image data can not be achieved by RapidEye, these first results present its data in combination with the object-based classification as a good alternative to carry out agricultural monitoring duties with change-detection-methods in order to identify trends and structural landscapes changes in a fast and cost-efficient way.

References

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