EARTH CASE STUDY

Combining HyMap-data with a DEM for vineyard mapping

The steep slopes along the rivers of middle Germany allow the cultivation of wine at latitudes where it would usually never be possible. The vineyards are mainly found on steep southwestern slopes with a high number of sunshine hours. By integrating a DEM in the classification of airborne HyMap-data this a-priori knowledge may be used to enhance the classification results.

In considering the raw data that was available for the eCognition work, two questions arose:
How well can the DEM and hence the a-priori knowledge about vineyards be integrated into the classification? To what extent will the object outlines produced during the segmentation of the geometrically high resolution HyMap-data match the real situation and how can the form features of objects be used for an optimized classification?

Fig. 1: 1st principle component

Fig. 2: Preclassification Result

After a very accurate radiometric and geometric correction of the raw data the 128 HyMap bands at a resolution of 5 meters after resampling were transformed into four principle components. In this way approximately 99% of the spectral information could be used while minimizing the data size.

The 20-meter-DEM was downscaled to 5 meters by bilinear interpolation to match the spectral data. For the analysis two layers, one with the slope and one with the aspect of the given area, were imported into Definiens eCognition together with the principle components. All data could then be used both for segmentation and for classification.

Preclassification

To integrate the terrain information, it was decided to first classify with the classes possibly wine and no wine only. The objects classified as possibly wine had an aspect between 160° and 270° with a slope steeper than 5.5°. The segmentation parameters of the classified layer were designed to respect the terrain information.

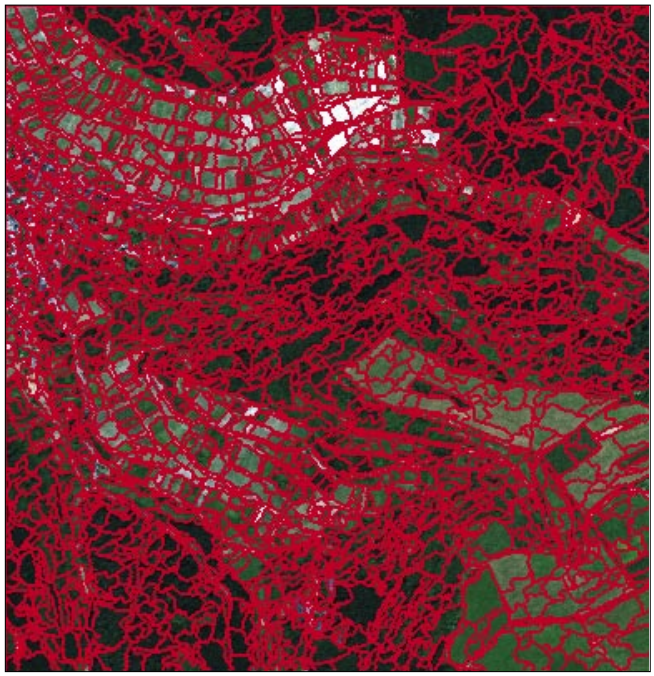

Fig. 3: Final Segmentation

The object size was relatively big and besides the first three principle components the slope layer was used for the segmentation. In this way one very important advantage of the object oriented approach could be used: The segmentation of the data functioned as a low pass filter, taking away the variance in the terrain data, which would have hindered the classification.

The result of this preclassification was projected onto a layer of very small sub-objects and the objects from the original classification layer were deleted. For the final classification a new segmentation layer was produced, designed to represent as

well as possible areas of equal land use. The segmentation was based on the four principle components. Since the objects of the preclassification had been deleted, the new object outlines were completely independent of the ones made to match the terrain information.
The new segmentation used the high geometric resolution of the HyMap data to an extent where even most of the narrow paths between vineyards could be distinguished. The object outlines were so accurate that form features could be used during the classification in a way that allowed very specific classes.

Final Classification

The class hierarchy for the final classification was based on membership functions only, separating the different classes step by step. A very high number of different object features could be used: At the highest level the preclassification (still existent in the sub-objects) was used to separate wine slopes from plateaus and northern slopes while the first principle component helped in the classification of coniferous forest and sealed areas. By using the preclassification, areas like densely vegetated fields and fallow vineyards could be classified discretely although the spectral information was quasi identical.

Further down in the inheritance hierarchy, the spectral information from the principle components was not used and object features that go beyond spectral information like form features or class-related features allowed a very sophisticated classification.

The comparison with a land use GIS showed the high quality of the final classification in terms of object borders as well as the land use itself.

Conclusions

Referring to the two questions initially raised, Definiens eCognition's object-oriented approach proved to be a good solution. The DEM data could be integrated easily and the low pass filter-effect of the object segmentation functioned better than a moving window. The preclassification based on terrain information allowed the a-priori knowledge to be included usefully.

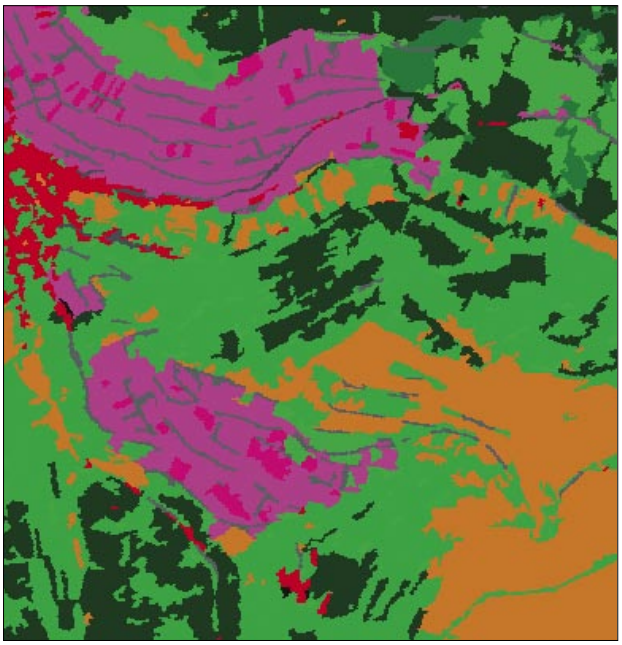

Fig. 4: Final Classification

The final segmentation produced meaningful and accurate object outlines and the additional object features helped in the optimization of the classification.

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