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Evaluation of Uncertainty and Accuracy in Multi-Temporal Object-Based Land Use Classification

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ABSTRACT:

The increased attendance of crop maps based on classification of remotely sensed data used in agricultural management induced a more detailed knowledge about the reliability of such spatial information. However, classification of agricultural land use is often limited by high spectral similarities of the studied crop types. More, spatially and temporally varying agro-ecological conditions can introduce confusion in crop mapping. Classification errors in crop maps in turn may have influence on model outputs, like agricultural production monitoring.

This study presents results of the PhenoS project ("Phenological structuring to determine optimal acquisition dates for Sentinel-2 data for field crop classification"), which is funded by the Federal Ministry for Economic Affairs and Energy, Germany. PhenoS aims at developing methods for the detection of optimal temporal windows for crop mapping in order to provide a more cost and calculation time efficient land use classification. For this purpose, coupling of multi-temporal spectral characteristics and phenological events is promising. One particular focus is set on the separation of spectrally similar cereal crops like winter wheat, barley, and rye. Study regions are the TERENO test-sites "The Harz/Central German Lowland" and "Demmin".

In this study, object based random forest (RF) classification was used to investigate the impact of image acquisition frequency and timing on crop classification uncertainty by permuting all possible combinations of available RapidEye time series recorded on the TERENO sites between 2010 and 2014. The permutations were applied to different segmentation parameters. Then, classification uncertainty was assessed and analysed, based on the probabilistic soft-output from the RF algorithm at the per-field basis. From this soft output, entropy was calculated as a spatial measure of classification uncertainty. The results of the study demonstrate that uncertainty estimates provide a valuable addition to traditional accuracy assessments and helps the user to allocate error in crop maps.

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