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# Object-Based Land Use Classification of Agricultural Land by Coupling Multi-Temporal Spectral Characteristics and Phenological Events in Germany

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Crop maps based on classification of remotely sensed data are of increased attendance in agricultural management. This induces 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.

One major goal of the PhenoS project ("Phenological structuring to determine optimal acquisition dates for Sentinel-2 data for field crop classification"), is the detection of optimal phenological time windows for land cover classification purposes. Since many crop species are spectrally highly similar, accurate classification requires the right selection of satellite images for a certain classification task. In the course of one growing season, phenological phases exist where crops are separable with higher accuracies. For this purpose, coupling of multi-temporal spectral characteristics and phenological events is promising. The focus of this study is set on the separation of spectrally similar cereal crops like winter wheat, barley, and rye of two test sites in Germany called "Harz/Central German Lowland" and "Demmin".

However, this study uses object based random forest (RF) classification 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 test 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 indicate that uncertainty estimates provide a valuable addition to traditional accuracy assessments and helps the user to allocate error in crop maps.