Using multi-temporal RapidEye remote sensing data to map semi-natural grassland communities

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ABSTRACT: Semi-natural grasslands are habitats with high biodiversity. Nature conservation and management initiatives, such such as the European Habitats Directive (Council Directive 92/43/EEC 1992) impose legal obligations to develop a monitoring framework for grasslands. However, monitoring through field surveys is time- and labour-intensive. In addition, field mapping is difficult to reproduce and prone to subjective interpretation. Remote sensing offers unique possibilities to map and monitor vegetation at large scales. We present a remote-sensing-based monitoring framework for semi-natural grasslands on a Natura 2000 site, using the Random Forest algorithm. The Grafenwoehr military training area is located in the south-east of Germany (Bavaria). A multi-temporal Rapid Eye time series (2014-2017) of 17 images was acquired covering different phenological phases. Field mapping for the two focus areas (Sommerhau: about 140 ha, 11 grassland community classes and Hoehenberg: about 71 ha, 10 grassland community classes), was carried out between 2014 and 2017. Based on the derived grassland community reference map, a stratified random sampling was implemented and repeated 100 times. Each training data candidate set was subsequently screened for potential outliers using the Random Forest proximity measure. The performance of each reduced training data candidate set was estimated using a 5-fold cross-validation approach. The final training data set was selected based on the ratio of Overall Accuracy and the range of the class specific F-score performance measure. Automated training data selection was successfully implemented and revealed good Overall Accuracies, ranging from 77.5 to 86.5%. Image acquisition dates from onset of vegetation (prespring, first spring) and senescence (late summer, first autumn) were identified as important phenological seasons. The estimated probability maps were able to describe transition zones between different grassland communities and can be seen as a better representation of real world conditions, compared to discrete maps. Incorporating future remote sensing data to the presented mapping strategy can identify hot spot areas of change. This will support the monitoring and reporting obligations as required under Ar.-17 of the EU Habitats Directive.

KEYWORDS: European Habitats Directive, monitoring, Random Forest, proximity, training data, variable importance, probability maps