# On the uncertainty associated with using macrophyte assemblages in environmental assessment

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## English summary

Aquatic vegetation has important ecological and regulatory functions and should be monitored in order to detect ecosystem changes. Field data collection is often costly and timeconsuming; remote sensing with unmanned aircraft systems (UAS) provides sub-decimetreresolution aerial images, offering a potential data source for vegetation mapping. In a manual mapping approach, UAS true-colour images with five-centimeter resolution pixels allowed for the identification of non-submerged aquatic vegetation at the species level. However, manual mapping is too labour-intensive to be implemented over large areas. While automated classification methods are available, they have rarely been evaluated when applied to aquatic vegetation, particularly at the scale of individual vegetation stands.

We have evaluated classification accuracy and time efficiency for mapping non-submerged aquatic vegetation at different levels of detail at five test sites (100 meter × 100 meter each) differing in vegetation complexity. We used object-based image analysis and tested two classification methods (threshold classification and Random Forest) using the software eCognition®. The automated classification results were compared to results from manual mapping.

Threshold-classification overall accuracy at the five test sites ranged from 93 to 99 % for the water-versus-vegetation level and from 62 to 90 % for the growth-form level. Random-Forest overall accuracy at the five test sites ranged from 56 to 94 % for the growth-form level and from 52 to 75 % for the dominant-taxon level.

Overall classification accuracy decreased with i creasing vegetation complexity. In test sites with more complex vegetation, automated classification was more time-efficient than manual mapping. This study demonstrated that automated classification of non-submerged aquatic vegetation from true-colour UAS images was feasible, indicating good potential for operative mapping of aquatic vegetation. When choosing the preferred mapping method (manual versus automated) the desired level of thematic detail and the required accuracy for the mapping task needs to be considered.

Of special interest to WATERS is that true-colour images taken by unmanned-aircraft-system with five-centimeter resolution will be highly available for ecological applications in the future. We show that ecologically relevant information (here, non-su merged aquatic vegetation) can be automatically - and with sufficient accuracy - extracted from these images. This offers high potential for future large-scale remote sensing and mapping of non-submerged aquatic vegetation.