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Semi-automatic image analysis of spatiotemporal vegetation evolution in the Hühnerwasser catchment

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The artificial Hühnerwasser catchment was built in a post-mining landscape (Brandenburg, Germany) as a field experiment to observe and monitor early-development ecosystems at first catchment scale. Given that the spatial distribution and temporal dynamics of vegetation affects water redistribution across scales, quantifying changes in vegetation distributions is an obvious indicator for state transitions, especially in the context of early ecosystem development.

In this work, we present a semi-automatic image analysis algorithm designed to identify vegetation patches during the early ecosystem development of the Hühnerwasser catchment (throughout 10 years) from aerial photography. Furthermore, the algorithm also allows to characterise vegetation cover, describe spatial structures and their temporal evolution. The earliest stages are especially of interest. The structure is therefore characterized by the area of the catchment covered by vegetation, the number of vegetation patches, the mean and maximum patch size and a form factor (area of patch divided by its perimeter). Base data are aerial images with a resolution at the centimeter scale. Because the imagery was obtained under very different lighting conditions and under different stages of plant growth, a luminance correction was applied in order to normalise colors, and thus be able of consistently binarise the images into vegetated-non vegetated maps. Binary maps were generated by setting thresholds for red, green and blue channels to differentiate between vegetation cover and bare soil. Additionally, bare soil areas were also identified using a similar procedure. To evaluate the consistency of the binary images of each channel these images were stacked and compared. For validation, the binary maps were compared to manually digitised vegetation patches for a subset of the data. The performance of the method was tested by using a set of combinations of thresholds and a comparison with manual mapping of vegetation cover at an image subset was made.

The blue channel seems to be very sensitive to detect vegetation and a better differentiation of vegetation and dark/wet soil can be achieved by setting the thresholds of

the channels in a specific order. The structures derived by the classification into vegetated and bare soil are more important in the early years of ecosystem development. In those years (2007 to 2011) the largest changes took place. As time advances vegetation became less patchy, and a mix of different vegetation spawns. By comparing the areas identified as (green) vegetation and those areas identified as bare soil, it is also possible to discriminate non-green vegetation, such as dry grasses, and thus achieve a minimal level of decomposition of the imagery into plant functional types.