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Networked web-cameras monitor congruent seasonal development of birches with phenological field observations

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Ecosystems' potential to provide services, e.g. to sequester carbon is largely driven by the phenological cycle of vegetation. Timing of phenological events is required for understanding and predicting the influence of climate change on ecosystems and to support various analyses of ecosystem functioning. We established a network of cameras for automated monitoring of phenological activity of vegetation in boreal ecosystems of Finland. Cameras were mounted on 14 sites, each site having 1-3 cameras. In this study, we used cameras at 11 of these sites to investigate how well networked cameras detect phenological development of birches (Betula spp.) along the latitudinal gradient. Birches are interesting focal species for the analyses as they are common throughout Finland. In our cameras they often appear in smaller quantities within dominant species in the images. Here, we tested whether small scattered birch image elements allow reliable extraction of color indices and changes therein. We compared automatically derived phenological dates from these birch image elements to visually determined dates from the same image time series, and to independent observations recorded in the phenological monitoring network from the same region. Automatically extracted season start dates based on the change of green color fraction in the spring corresponded well with the visually interpreted start of season, and field observed budburst dates. During the declining season, red color fraction turned out to be superior over green color based indices in predicting leaf yellowing and fall. The latitudinal gradients derived using automated phenological date extraction corresponded well with gradients based on phenological field observations from the same region. We conclude that already small and scattered birch image elements allow reliable extraction of key phenological dates for birch species. Devising cameras for species specific analyses of phenological timing will be useful for explaining variation of time series of satellite based indices, and it will also benefit models describing ecosystem functioning at species or plant functional type level.

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