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Using canopy metrics to describe vegetation dynamics and their effects on CO_2 exchange in peatlands

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Canopy metrics can be used to quantitatively describe vegetation dynamics and thereby to parameterize the functional role of phenology and succession in ecosystem studies. Although such data can be easily obtained from digital cameras or satellite imagery, so far only few studies have incorporated canopy metrics to investigate the peatland C cycle. Here, I give an overview of application fields of canopy metrics to describe vegetation dynamics in peatlands and constrain its effect on CO_2 exchange. The presented application examples span from continental-scale network studies down to plot-scale field trials.

Typically, canopy metrics derived from digital RGB cameras are used to identify plant life-cycle events of individual ecosystems. When implemented in joint research activities such as the European PhenoPeatCam network, such canopy color indices can reveal peatland-specific patterns of phenological timing across geographic gradients. Beyond that, continuous time series of canopy greenness can be used to parameterize the functional effect of phenology on peatland CO_2 exchange. I will present a model approach developed within the PhenoPeatCam network that constrains phenological effects on the gross ecosystem productivity of peatlands under consideration of existing interdependencies with abiotic controls. Incorporating such biotic-abiotic linkages into empirical models can advance our mechanistic understanding of the peatland C cycle.

Further, vegetation dynamics are in the focus of many peatland restoration projects and tightly linked with photosynthetic CO_2 uptake and peat formation. I will report on using satellite-derived vegetation indices to describe the shifts in vegetation and phenological timing that occurred after flooding of a minerotrophic fen. The observed vegetation dynamics could be well related to the interannual variation in peatland CO_2 exchange. Finally, I will discuss ongoing research on the deployment of digital RGB cameras in restoration experiments. Here, image archives can be used to parameterize plant colonization on plot scale and thereby improve predictive CO_2 exchange models.