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Carbon-aware management of nature conservation areas: a case study from Flanders

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Land-use, land-use change and Forestry (LULUCF) have long been recognized as essential drivers and potential mitigators for climate change. Nevertheless, realizing this potential in actual field conditions is not straightforward. In the framework of the Climate Plan of the Flemish government, an initiative was set up to evaluate how nature conservation areas, including forests, could contribute to lowering or even offsetting emissions. A major hurdle however is that, in a densely populated area like Flanders, conservation areas have to accommodate multiple ecosystem functions and often have a strong focus on safeguarding endangered biodiversity. Hence, drastic changes in management techniques, vegetation or soil amendments used in e.g. an agricultural context, are not feasible here. Moreover, an earlier study in the same area by Ottoy et al. identified the importance of hotspots in a conservation context: these are small land units with considerably higher carbon stocks compared to the surrounding landscape matrix, such as peatlands and Anthrosols. Hence, we propose a spatially specific approach, aimed at predicting the location of the hotspots by a model-based approach using remote sensing data, maps and legacy measurements, as currently no systematic soil carbon monitoring system is in place in Flanders. Using existing models typically evened out extremes of soil carbon content in the landscape, especially at plot level. Hence, several adaptations to the model were evaluated for their potential to improve predictions (signal map). Second, a framework was proposed to assess the hotspots' relative inertia to management, assuming that -like all ecosystems- they may show non-linear behavior towards external drivers and management. Indeed, land units that are in a zone of pedological inertia will not respond significantly to small or moderate changes in management. Systems near a tipping point however, are more likely to respond to change, either positively or negatively (vulnerability map). Finally, we reviewed typical management practices for conservation areas in Flanders for their potential impact on soil carbon stocks.
Many knowledge gaps still remain, both in the signal map as in the vulnerability map and management options. Nevertheless, by adding a spatially specific compound at landscape level to the discussion, zones of priority can be established both for current management as for future research.