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Vulnerability of carbon sinks and nutrient retention to climate change: spatial analysis at a boreal catchment

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Boreal forests and croplands regulate climate and water quality, and provide raw material, food and renewable energy for society. The vulnerability of these ecosystem services to climate change needs to be evaluated to support mitigation and adaptation policies. The observed increase in the annual temperature is projected to continue in the boreal zone, with accompanying changes in precipitation patterns. These changes may reduce the carbon sink capacity and nitrogen retention potential of soils due to accelerating decay of soil organic matter and increasing runoff. The climate-induced changes of carbon and nitrogen fluxes can be estimated using dynamic, catchment-level modeling tools. We present a study quantifying the impacts of climate change on two key ecosystem service indicators: 1) carbon stocks and sinks of biomass and soil and 2) nutrient loading to surface waters and drinking water supplies. The modelling framework integrates high-resolution spatial data on land cover and dynamic modelling of soil carbon cycle and nutrient loading (1-3). The study region encompasses the Lammi LTER (Long-Term Ecosystem Research) monitoring site in southern Finland. The study is part of an EU Life –funded project MONIMET: Climate Change Indicators and Vulnerability of Boreal Zone Applying Innovative Observation and Modeling Techniques (LIFE12 ENV/FI/000409, 9/2013-9/2017). We present estimates of the spatial variation, temporal trends and trade-offs between these ecosystem service indicators at the landscape scale. The modelling framework developed can be applied to verify the integrated ecological effects of forest management scenarios across an actual landscape where land-use decisions take place. Mapping can also reveal the most sensitive and vulnerable areas for climate change.

References

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