Water and nutrient management in peatland forests under changing climate

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Different climate scenarios agree in predicting rising temperatures to high latitudes, but are contradictory in predictions for the future amount and distribution of rainfall in Fennoscandia. Rainfall is, by far, the most important individual variable determining the fate and the future use of peatland forests. In the case where the summertime rainfall decreases, the management schemes of peatland forests are facing a fundamental change. Lowering water table and increasing peat temperature will enhance organic matter decomposition leading to higher nutrient release and CO_2 emissions from the peat. Improved nutrient supply can increase forest growth, which typically is phosphorus (P) and potassium (K) limited. During rainless periods peatlands can longer maintain the water storage supporting the forest growth better than the upland mineral soils, where the water storage is smaller. Consequently, the relative importance of peatland forests in biomaterial production is likely to increase. Meanwhile, it is imperative to control the greenhouse gas emissions and nutrient exports from forested peatlands. This requires improved water and nutrient management strategies that aim for balanced production of multiple ecosystem services at the same time. This can be achieved with new drainage, forest management and fertilization schemes. Hydrological and biogeochemical processes in forested peatlands are complicated, interlinked and characterized by different feedback mechanisms. In addition, all these are dependent on weather conditions, peat characteristics, drainage dimensions, and stand structure. High-resolution geospatial data combined with process-based ecosystem models provides a solution in searching for new forest management schemes that balance between different ecosystem services. We have developed this kind of ecosystem model, peatland simulator SUSI, and applied it to study how manipulation of drain network, ash fertilization and forest management affect tree growth, greenhouse gas balance and nutrient export to water courses under different rainfall scenarios.