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Integrating McGill Wetland Model (MWM) with microbial controls and corhot development

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In peatland ecosystems, there are close feedbacks between the dynamics and metabolism of microbial communities and the quality and quantity of organic matters accumulated in peat profiles. However, such feedbacks are poorly described or linked to environmental changes in many peatland models. Here we developed MWCM (McGill Wetland Cohort Microbial model) by integrating MWM (McGill Wetland Model) with MEND (Microbial-Enzyme-mediated Decomposition) model, PCARS (the Peatland Carbon Simulator) and MILLENNIA peat cohort model. Three major development to original MWM were: (1) the simple acrotelm-catotelm decomposition model in MWM was changed into a cohort, multilayer model, in order to track the changes in litter chemistry and decomposability; (2) microbial growths and metabolisms were introduced to modify the decaying rate; and (3) the accumulation and transport of DOC (Dissolved Organic Carbon) were added and used to regulate the growth of microbial biomass. The model is novel in its ability to derive fine peat vertical profile with more details, e.g. the priming effect in peatland and possible formation of mesotelm due to DOC accumulation near long-term water table. A preliminary evaluation of the model's outputs was conducted against the measurements at the Mer Bleue, a raised ombrotrophic bog located in southern Ontario, Canada. Model sensitivities were tested for changes in temperature, water table and uncertain microbial parameters. With the incorporation of microbial and cohort model, MWCM could shed more light on the dynamics and functioning of peatland ecosystems.