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Functional Divergence in CO_2 Exchange Among Vascular Plant Communities in a Temperate Ombrotrophic Peatland

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Plant functional types (PFTs) are used to classify vegetation into groups that demonstrate similar responses to changes in environmental conditions. In this study, we investigated the potential for differentiating CO_2 exchange among three vascular plant communities (Chamaedaphne, Maianthemum/Ledum, and Eriophorum) with different dominant species and microclimatic characteristics at the Mer Bleue bog in Canada. Using an automatic chamber system, we examined the seasonal patterns of net ecosystem CO_2 exchange (NEE), gross ecosystem production (GEP), and ecosystem respiration (ER), as well as the responses of GEP and ER to changing environmental and biotic conditions among communities in 2009. While seasonal mean NEE were similar among the three plant communities, seasonal mean GEP and ER were significantly lower in the Maianthemum/Ledum community owing to the lower green biomass and higher water table. Based on the parameterized GEP models, we detected a significant decrease in effective quantum yield in the order of Eriophorum > Chamaedaphne > Maianthemum/Ledum community, indicating the most efficient photosynthetic activity in sedges at lower light levels. The rate of linear increase in GEP with vascular green area index was considerably lower in the Maianthemum/Ledum community, in relation to the high specific leaf area of forb foliage. We found that maximum gross photosynthesis (Pmax) per unit ground area had a clear seasonal pattern with a single peak in mid-summer, but Pmax per unit green area varied much less over time. This suggests that the temporal changes in community-level Pmax are predominantly controlled by variations in green area rather than variations in photosynthetic capacity per unit green area. The ER model parameters were significantly different among communities, with the highest temperature sensitivity of ER in the Eriophorum community. The three communities each represent a distinct PFT as their CO_2 exchange processes respond to environmental forcing in different ways, and hence should be taken into account separately in modelling the CO_2 fluxes as well as interpreting the spatially integrated NEE measured by the micrometeorological technique in this peatland.