



Quantifying the Net Exchanges of Carbon Dioxide and Methane between the Atmosphere and Terrestrial Biosphere in Northern High Latitudes

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Wetlands occupy vast areas in boreal regions (above 45°N) and play an important role in the regional exchanges of carbon dioxide (CO₂) and methane (CH₄) between land ecosystems and the atmosphere. We have developed a biogeochemistry model that considers the effects of thawing permafrost and complex hydrological dynamics on plant photosynthesis, plant nutrient uptake, and both aerobic and anaerobic decompositions of organic carbon of wetland ecosystems in this region. The process-based biogeochemistry model was applied to evaluate how spatial and temporal variations in both CO₂ and CH₄ have changed in the last century and will change during this century. Our current estimate of net CH₄ emissions from this region is 67.8±6.2 Tg CH₄ yr⁻¹ during the period of 1993-2004. In contrast, we estimate that the region acts as a net carbon sink of -1.28±0.03 Pg C yr⁻¹ with a persistent wetland carbon sink from -0.38 to -0.41 Pg C yr⁻¹ and an upland sink from -0.6 to -1.1 Pg C yr⁻¹. Our analysis indicates that wetlands play a disproportionately important role in affecting regional greenhouse gas budgets given that they only occupy a small fraction of the total land area in the region. In addition, this talk will present our model projections of both CO₂ and CH₄ dynamics in the region during the 21st century. More importantly, this talk will make recommendations on data collection and model improvement based on our decade-long modeling efforts in this region.