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MEASUREMENT AND MODELING OF THE SOURCES AND SINKS OF GREENHOUSE GASES FROM NORTHERN WETLANDS

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Northern wetlands contain ≈30% of the world's terrestrial carbon store, resulting from the incomplete decomposition of plant material inhibited because oxygen diffusion is limited by water saturation of the soil. While this behaviour results in a sink for CO_2, anaerobic pathways of decomposition result in wetlands being a large, but variable, source of CH_4. Northern wetlands tend to be nitrogen-impoverished, therefore they are not an important source of N_2O. However, nitrogen deposition, peat extraction, and other land-use changes have the potential to alter their greenhouse gas (GHG) sink/source function.

Until recently, most of the studies on the atmosphere-biosphere exchange of greenhouse gases from northern wetlands were short-term and seasonal. In 1998 the Peatland Carbon Study began continuous measurements of the carbon dynamics of a northern peatland and developed several ecosystem models to be used in simulations of the response of peatlands to climate variability and change. The continuous measurements have established the dominant role of climate variability in determining the magnitude and sign of the fluxes of GHGs. The Peatland Carbon Simulator (PCARS) was developed to use either direct measurements or modeled climate from a land surface process model such as the Canadian Land Surface Scheme (CLASS) which has been modified to incorporate the physical attributes of wetlands as inputs. PCARS illustrates the relative importance of various components of the ecosystem in determining the interannual variability in GHG exchange. Evaluation of PCARS has helped identify significant gaps in our knowledge of peatland systems. A second, more phenomenological

model, the Peat Accumulation Model (PAM), demonstrates the overall importance of precipitation in controlling decadal to millennial scale variations in sink/source strength of CO_2. The Canadian Global Coupled Climate Carbon Model (CGC^3M) Network is attempting to parameterize wetland processes for the inclusion in a global terrestrial ecosystem model for climate simulations, but it is a significant challenge to develop an efficient, yet realistic, wetland simulator for global scale modelling.