

Scott Miller, Project Director
Atmospheric Sciences Research Center (ASRC)

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Collaborative Research: Arctic to the Amazon: Physical Processes Controlling Gas Exchange from Freshwater Ecosystems

Despite the small overall surface area of lakes, reservoirs, streams, and rivers, estimates of carbon dioxide and methane emissions indicate aquatic ecosystems play an important role in carbon balances across multiple scales ranging from the local (ecosystem) scale to the regional and global scales. Lakes are also anticipated to be sentinels of climate change, with the balance between autotrophic growth and respiration in lakes predicted to change with increased anthropogenic activity in their watersheds and with climate change. Studies have been and are being conducted worldwide to assess the role of lakes and reservoirs in regional and global carbon cycles and efforts are underway to estimate metabolic activity in lakes. Essential to these efforts are accurate estimates of gas fluxes at the air-water interface. The proposed research includes an array of field measurements of gas exchange and processes controlling gas exchange across a range of freshwater bodies from small arctic lakes to the large floodplain lakes of the Amazon. These data will be used to validate and improve air-water gas exchange models for freshwater ecosystems (e.g., surface renewal) that are used in biogeochemical models across multiple scales. This multi-scale approach to the measurement and analysis of gas exchange, and the development of gas exchange models over a wide range of latitude, will result in a formulation of the gas transfer coefficient that can be readily applied in ecosystem studies of lakes at any latitude.

Results of the proposed research will inform procedures at Global Lake Ecological Observatory Network (GLEON) sites worldwide, and also proposed lake sites within the National Ecological Observatory Network (NEON). Postdoctoral fellows and graduate students in the U.S. and abroad will receive training in micrometeorology, limnology, and biogeochemistry. We will contribute units on physical limnology to the field course being funded by the Arctic Observational Network at the Toolik Lake Field Station and to GLEON Workshops and will conduct workshops at ASLO meetings.