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Long term flux measurements of carbon dioxide and methane over a small boreal lake using eddy covariance technique

Ivan Mammarella[1], Joonatan Ala-Könni[1], Marta Fregona[1], Jouni Heiskanen[2], Kukka-Maaria Kohonen[3], Asta Laasonen[1], Xuefei Li[1], Sally MacIntyre[4], Anne Ojala[5], Aki Vähä[1], and Timo Vesala[1]

[1]University of Helsinki, Institute for Atmospheric and Earth System Research (INAR) / Physics, Helsinki, Finland
[2]Faculty of Biological and Environmental Sciences, University of Helsinki, Helsinki, Finland
[3]Department of Environmental Systems Science, ETH Zurich, Zürich, Switzerland
[4]Earth Research Institute, University of California, Santa Barbara, California
[5]Natural Resources Institute Finland (Luke), Helsinki, Finland

Advancing our understanding on physical and biogeochemical processes controlling turbulent exchange of energy, carbon dioxide (CO_2), methane (CH_4) and other trace gases across lacustrine systems is crucial in order to improve climate and weather forecast models. Lakes are capable of processing large amounts of organic carbon of terrestrial origin, and their importance in landscape carbon cycle and climate change issues is well recognized. Nevertheless, the amount of CO_2 and CH_4 released into the atmosphere is still uncertain.

Here, we investigate the temporal dynamics of CO_2 and CH_4 exchange using eleven years (for CO_2) and three years (for CH_4) of eddy covariance flux measurements over the Lake Kuivajärvi, a small boreal lake in southern Finland.

The lake ecosystem acted mostly as a net CO_2 source (0.42±1.56 mmol m^{-2} s^{-1}) throughout the ice-free periods and had a relatively high interannual variability when compared to the surrounding forests and wetlands. On average, the lake is a net source of CH_4 (0.63±2.44 nmol m^{-2} s^{-1}), but the measured annual emissions are lower than for CO_2, revealing thatmost of the CH_4 produced at the lake bottom is oxidized in the water column. Carbon dioxide and methane emissions are largely affected by the weather forcing through the effects of wind shear and nocturnal water cooling, which deepens the mixed layer and enhances gas exchange at the air-water interface.