Geophysical Research Abstracts, Vol. 7, 04082, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04082

CO_2 Fluxes from a Boreal Lake over Two Open-water Periods with Contrasting Weather Patterns and DOC Loads

J. Huotari (1,3), A. Ojala (1), E. Peltomaa(1) and T. Vesala (2)

(1) University of Helsinki, Department of Ecological and Environmental Sciences, Niemenkatu 73, FIN-15140 Lahti, Finland, (2) University of Helsinki, Department of Physical Sciences, P. O. Box 64, FIN-00014 University of Helsinki, Finland, (3) Now at the University of Helsinki, Lammi Biological Station, Pääjärventie 320, FIN-16900 Lammi, Finland (jussi.huotari@helsinki.fi)

Lake's functioning as a sink or a source of trace gases is governed by the concentration difference between the surface water and the overlying air. The biological activities in epilimnion of a lake can have a great impact on carbon dioxide (CO_2) exchange by changing the aqueous concentrations of CO_2. In photosynthesis CO_2 is consumed by the autotrophic organisms and through this process solar irradiance is of great importance in determining the rate of CO_2utilisation. On the contrary heterotrophic respiration releases CO_2 and thus increases the CO_2 concentration in the water. In low productive humic waters heterotrophic respiration often exceeds autotrophic production and is thus supported by substrates of allochthonous origin. Besides of organic carbon of autochthonous origin, particulate (POC) as well as dissolved (DOC) organic carbon produced in the surrounding catchment area and washed into the lake offers substrates for heterotrophic respiration. It can also affect the light climate of the lake by increasing water colour and enhancing attenuation of light which then can result in reduction of photosynthesis. In general, catchment's quality and prevailing weather conditions, for instance rainfall, play an important role in transport of allochthonous organic carbon into the lake.

In 2003 and 2004 we examined interactions of epilimnetic water chemistry, biological processes and CO_2 fluxes on a small humic lake, Lake Valkea-Kotinen, in southern Finland (61˚14´N, 25˚03´E). For flux measurements we used micrometeorological eddy covariance methodology (EC) which offers a technique to directly measure at a

short time-scale trace gas fluxes continuously without affecting the natural gas transfer between water and atmosphere. The lake was sampled weekly for chemical data. Primary production in the photic zone was determined once a week using the ^{14}C method with 24-h *in situ* incubations. Simultaneously with the primary production measurements total respiration of the epilimnetic plankton community was determined *in situ* as the increase in DIC concentration in dark bottles over a 24-h incubations.

The results showed that in 2004 the lake was about four fold larger source of CO_2 than in 2003. Respiration to primary production ratio was higher in 2004 comparing to 2003 when the ratio was close to unity and primary production was consistently lower in 2004 than in 2003. A plausible explanation for the differences between the years lies behind the rainfall. In 2004 summer was extremely wet, i.e. the rainfall in June-September increased by ca. 30 % in comparison to the previous year and the water colour – measuring the DOC load - of the lake subsequently doubled from the average of ca.120 mg Pt l^{-1} to $>$200 mg Pt l^{-1}. That affected both CO_2 uptake, i.e. primary production via faster attenuation of light and CO_2 release, i.e. respiration through an additional source of carbon for heterotrophs. Thus we conclude that the change in rainfall led to increased input of organic carbon into the lake which then caused the observed shift to higher level of heterotrophy of the lake and finally resulted in a clearly higher CO_2 flux.