Geophysical Research Abstracts
Vol. 14, EGU2012-12116, 2012
EGU General Assembly 2012

Intense methane emission by a temperate reservoir driven by high sediment deposition: implications for localizing ebullition hot spots

S. Sobek (1), T. DelSontro (2,3), N. Wongfun (3), W. Eugster (3), B. Wehrli (2,3)

(1) Department of Ecology and Evolution, Limnology, Uppsala University, Sweden (sebastian.sobek@ebc.uu.se), (2) Eawag, Swiss Federal Institute of Aquatic Science and Technology, Kastanienbaum, Switzerland, (3) ETH, Swiss Federal Institute of Technology, Zurich, Switzerland

Organic carbon (OC) burial and greenhouse gas emission of inland waters plays an increasingly evident role in the carbon balance of the continents. We have studied the carbon budget of a temperate run-of-the-river reservoir, using a mass balance approach in combination with gas traps and eddy covariance measurements. We found the highest methane (CH4) emission rates reported so far for mid-latitude reservoirs (annual average 150 mg CH4 m-2 d-1, maximum 500 mg CH4 m-2 d-1). In contrast to most other reservoirs, the majority of CH4 emission (80%) was due to bubble evasion (ebullition). Methane emission was strongly and exponentially dependent on temperature, with additional short-term variability explained by changes in water level and air pressure. Studies of the sediment revealed extremely high sediment accumulation rates, and thus a very rapid transport of recently deposited OC to deep, anoxic sediment strata (1100 g C m-2 yr-1). Hence, OC degradability is high throughout the sediment profile, fuelling methanogenesis. Since diffusion through low-porosity sediment is very limited, the CH4 formed in deep sediment layers (>10 cm) accumulates at depth, and will eventually form bubbles. Thanks to the shallow water column of the reservoir (mean depth, 9 m), the bubbles released from the sediment dissolve only to a minor extent (30%), thus bypassing aquatic CH4 oxidizers and releasing CH4 to the atmosphere. Different markers indicate that the bulk organic matter in the sediment is derived from terrestrial sources, but since CH4 emission corresponds to only 3% of the OC burial flux, the source of the CH4 could not be constrained from sediment data. Even though the reservoir is a strong carbon sink due to rapid OC sediment burial, damming of the river has resulted in the build-up of highly methanogenic sediments overlain under a shallow water column, facilitating the transformation of fixed carbon dioxide to atmospheric methane. Similarly high rates of OC burial and CH4 ebullition can be expected in other reservoirs and natural river deltas, as demonstrated by recent reports of ebullition hot spots in the river deltas of a large tropical reservoir.