Geophysical Research Abstracts
Vol. 20, EGU2018-17707, 2018
EGU General Assembly 2018

Climate-driven changes in removal of DOC in a small boreal lake: a 30-year time series.

Heleen A de Wit (1), Raoul-Marie Couture (1,2), Martyn N. Futter (3), Rolf D Vogt (4), Pawel Krzeminski (1), Elena Martínez Francés (4), Stevenson Ong (4), Leah Jackson-Blake (1), Kari Austnes (1), Jose-Luis Guerrero (1), and Salar Valinia (1)

(1) Norwegian Institute for Water Research, Oslo, Norway (heleen.de.wit@niva.no, pkr@niva.no, ljb@niva.no, kau@niva.no, jlg@niva.no, sva@niva.no), (2) Département de Chimie, Université Laval, Québec, Canada (rmc@niva.no), (3) Swedish University of Agricultural Sciences, Uppsala, Sweden (martyn.futter@slu.se), (4) Department of Chemistry, University of Oslo, Norway (r.d.vogt@kjemi.uio.no,e.m.frances@kjemi.uio.no,s.h.l.ong@kjemi.uio.no)

Are small lakes passive pipes transporting terrigenous dissolved organic matter (DOM), or are they reactors for DOM-processing, acting as chimneys for CO_2 release in the landscape? We used a unique combination of 30-year measurements, sediment dating, continuous high-frequency monitoring of temperature and oxygen at various lake depths, and process-based modelling (MyLake model) of a small humic lake (0.23 km^2) and its catchment (4.8 km^2) in southeast Norway, to calculate lateral DOC fluxes, in-lake DOC retention and rates of DOC removal. Concentrations and fluxes of DOC rose significantly, driven by declining sulfur deposition and increased precipitation. In-lake retention was on average 8% of catchment DOC inputs, and declined significantly ($p<0.05$) as a consequence of higher discharge and lower residence times. DOC removal rates (yr^{-1}) declined significantly ($p<0.05$), and were positively related to water residence time.

Modelled in-lake DOC removal was driven primarily by microbial metabolism and, secondarily, by flocculation, suggesting that the most likely fate of lake-retained DOC is CO_2 evasion to the atmosphere. Microbial mineralization of DOC in the model assumes that allochthonous DOM is semi-labile, and that the overall microbial mineralization rate is a function of a rate constant characteristic for semi-labile DOM, temperature and oxygen. The lake removal of DOM was described well by the model. The distribution of DOM across size fraction (measured with Tangential Flow Filtration) indicates that the outlet DOM is of slightly lower size than the inlet DOM and is more biodegradable (biodegradability assessed by oxygen consumption). The change in DOM character between inlet and outlet suggests that in-lake processing, in particular photo-degradation, in this boreal, humic headwater lake potentially increases the lability of terrestrial DOM.

Precipitation was the overriding landscape control on DOC fluxes and retention. In a wetter climate, small northern lakes will, on balance, function more as pipes than chimneys, with increasing lateral DOC fluxes but little change in CO_2 production.