A process-based model applied to paleolimnology to reconstruct the long-term carbon sequestration and oxygen dynamic in lake Geneva (France)

J-P. JENNY*[1], P. FRANCUS[1], R. COUTURE[2], F. CLAYER[1], N. CARVALHAIS[3], J. JAUTZY[4], M-E. PERGA[5]

[1]Centre - Eau Terre Environnement, INRS, G1K 9A9 Québec (Qc), Canada (correspondance: Jean-Philippe.Jenny@ete.inrs.ca; Pierre.Francus@ete.inrs.ca; Clayer@ete.inrs.ca)
[2] Norwegian Institute for Water Research, Oslo, Norway (raoul.couture@niva.no)
[3] Max Planck Institute for Biogeochemistry, 07745 Jena, Germany (ncarvalhais@gmail.com)
[4] Department of Earth Sciences, University of Ottawa, ON, Ottawa K1N6N5 (jjautzy@uottawa.ca)
[5] INRA UMR 42 CARRTEL, Université de Savoie, 74203 Thonon-les-bains Cedex, France (marie-elodie.perga@thonon.inra.fr)

Land cover/use and nutrient emissions were identified as external causes of the global spread of hypoxia onset in lakes at the turn of the 1900s [1]. However, long-term processes causing lakes hypoxia are challenging to investigate because 1) the dearth of long-term monitoring data prevents any observation of the hypoxia onset in the 1900s, and 2) the low temporal resolution of most paleolimnological reconstructions is not well adapted to investigate intra-annual processes. Furthermore, proxy-based reconstructions provide indirect past conditions (they are not direct measurements) and hence comprise relative biases. Still, process-based lake models could overcome part of these limitations, but until now theses models were used quite exclusively for short-time periods (<60 years). Here, to investigate processes (and not only external forcings) causing lacustrine hypoxia and carbon sequestration over long time periods, we rely on 1) high-resolved time series data from limnology and paleolimnology and 2) process-based model *MyLake* (Multi-year simulation model for Lake thermo- and phytoplankton dynamics model).

MyLake is a one-dimensional simple mechanistic model for predicting lake stratification, total phosphorus, primary production and oxygen conditions [2]. MyLake is tested here on the deep perialpine Lake Geneva, which shifted to hypoxia in CE 1952 following eutrophication in the first half of the 20th century. Lake Geneva is among the few lakes in the world that have been monitored for > 60 years, records varved sediments i.e. annual laminated sediments, and has been intensively investigated in paleolimnology [3].

[1] Jenny et al. (2016) Glob. Chang. Biol. 10.1111/gcb.13193 [2] Couture et al (2015) J Geophys Res 120, G003065 [3] Perga et al. (2015) Front. Ecol. Evol. 10.3389/fevo.2015.0007.