Geophysical Research Abstracts
Vol. 16, EGU2014-5282, 2014
EGU General Assembly 2014

Biogeochemical mass balances in a turbid tropical reservoir. Field data and modelling approach

Thuy Kim Phuong DOAN (1), Julien NÉMERY (1), Nicolas GRATIOT (1), and Martin SCHMID (2)

(1) Univ. Grenoble Alpes, CNRS, IRD, LTHE (UMR5564), 38000 Grenoble, France, (2) Eawag: Swiss Federal Institute of Aquatic Science and Technology, Surface Waters - Research and Management, CH-6047 - Kastanienbaum, Switzerland

The turbid tropical Cointzio reservoir, located in the Trans Mexican Volcanic Belt (TMVB), behaves as a warm monomictic water body (area = 6 km^2, capacity 66 Mm^3, residence time $\sim$ 1 year). It is strategic for the drinking water supply of the city of Morelia, capital of the state of Michoacán, and for downstream irrigation during the dry season. This reservoir is a perfect example of a human-impacted system since its watershed is mainly composed of degraded volcanic soils and is subjected to high erosion processes and agricultural loss. The reservoir is threatened by sediment accumulation and nutrients originating from untreated waters in the upstream watershed. The high content of very fine clay particles and the lack of water treatment plants lead to serious episodes of eutrophication (up to 70 μg chl. a L-1), high levels of turbidity (Secchi depth $<$ 30 cm) and a long period of anoxia (from May to October).

Based on intensive field measurements in 2009 (deposited sediment, benthic chamber, water vertical profiles, reservoir inflow and outflow) we determined suspended sediment (SS), carbon (C), nitrogen (N) and phosphorus (P) mass balances. Watershed SS yields were estimated at 35 t km^2 y^{-1} of which 89-92 % were trapped in the Cointzio reservoir. As a consequence the reservoir has already lost 25 % of its initial storage capacity since its construction in 1940. Nutrient mass balances showed that 50 % and 46 % of incoming P and N were retained by sedimentation, and mainly eliminated through denitrification respectively. Removal of C by 30 % was also observed both by sedimentation and through gas emission.

To complete field data analyses we examined the ability of vertical one dimensional (1DV) numerical models (Aquasim biogeochemical model coupled with k-ε mixing model) to reproduce the main biogeochemical cycles in the Cointzio reservoir. The model can describe all the mineralization processes both in the water column and in the sediment. The values of the entire mass balance of nutrients and of the mineralization rates (denitrification and aerobic benthic mineralization) calculated from the model fitted well to the field measurements. Furthermore, this analysis indicates that the benthic mineralizations are the dominant processes involved in the nutrients release.

This is the first implementation of a biogeochemical model applied to a highly productive reservoir in the TMVB in order to estimate nutrients release from sediments. It could be used for scenarios of reduction of eutrophication in the reservoir. This study provides a good example of the behavior of a small tropical reservoir under intense human pressure and it will help stakeholders to adopt appropriate strategies for the management of turbid tropical reservoirs.