O12.1

The effects of hydrological extremes on nitrogen loss through denitrification and recycling via DNRA and mineralization in a coastal lagoon

Monia Magri[1,2], Sara Benelli[1], Stefano Bonaglia[3,4], Mindaugas Zilius[2,5], Giuseppe Castaldelli[5], Marco Bartoli[1,2]

[1]University of Parma, Italy. [2]University of Klaipeda, Lithuania. [3]University of Stockholm, Sweden. [4]University of Southern Denmark, Denmark. [5]University of Ferrara, Italy

Abstract

Hydrological extremes, which are periods characterized by unusually high or low discharge, may have profound effects on nitrogen transport and on sediment biogeochemistry in transitional zones, but such effects are poorly explored. In this study, microbial nitrogen transformations were analyzed by means of intact core incubations and the ^{15}N-isotope addition at three sites (one freshwater and two marine ones) in a eutrophic lagoon both under high discharge (spring) and after prolonged low discharge (late summer) of the main freshwater inputs.

Results suggest a pronounced shift among dominant microbial N transformations with denitrification as leading process and little to no recycling during high discharge and high nitrate period, and high recycling during low discharge period. During spring the freshwater site exhibited the highest rates of N_2 production (up to 1150 ± 81 µmol N m^{-2} h^{-1}), mostly sustained by nitrification stimulated by burrowing macrofauna activity. During late summer denitrification dropped at all sites due to low discharge coupled with low nitrate concentration and to reduced bioturbation and nitrification. The highest recycling was measured at the marine sites and particularly at the clams cultivated area (up to 1003 ± 70 µmol NH_4^+ m^{-2} h^{-1}), and it was sustained by ammonification of biodeposits and excretion by bivalves. Concurrently, dissimilatory nitrate reduction to ammonium (DNRA) became an important path of N recycling, representing on average 30% of nitrate reduction processes.

Flash floods and high nitrate may offset denitrification due to reduced residence time and saturation of microbial activity, resulting in high transport of nitrate to the open sea. Prolonged dry periods favor large N regeneration by sediments, due to combination of high temperatures, low oxygen solubility and low bioturbation, which may prolong the extent of algal blooms, with negative feedbacks for the lagoon biogeochemical services.

Keywords

nitrogen, sedimentary fluxes, estuaries, climate change