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Hydrology and Earth System Sciences Discussions

Interactive comment on “Lacustrine wetland in an agricultural catchment: nitrogen removal and related biogeochemical processes” *by* R. Balestrini et al.

Anonymous Referee #1

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This manuscript is an interesting contribution to wetland studies, which aims at evaluating transformations and fate of the inorganic nitrogen bulk delivered to the Candia lake from the surrounding farmland. The paper provides new data dealing with the buffering capacity of wetlands towards diffuse pollution, which is one of the most valuable ecosystem service to be considered in protecting/restoring aquatic ecosystems, with possible applications in the WFD implementation.

Issues and rationale are sound; the experimental design is sufficiently clear (a better explanation of the sampling frequency could help readers) and materials and methods are standard. The manuscript is also formally acceptable.

I have some major comments.

1. Authors state that they examine spatial and temporal variations in water chemistry, but temporal series are not presented in the paper (figures 10 and 12 presents aggregated data). Data are handled and only median values (tables) or boxplots (figures) are reported in the manuscript. In figure 3, a sudden and marked increase (approximately 2 m) of water table in piezometers occurs after November 2003, coinciding with very heavy rainfalls. How do these changes affect concentrations of the different chemical species? I think that monthly variations of nitrate, chloride and alkalinity should be given for the same selected piezometers. Moreover, the very large min-max ranges in figures 5, 6 and 7 indicate that concentrations undergo very wide fluctuations.

2. The main conclusion of the paper is that the nitrate bulk is mainly processed through bacterial denitrification processes, which seems reasonable. However, this conclusion is mainly based on the assumption that the water is anoxic. I think that the assumption is questionable, since dissolved oxygen attains values up to 10 mg/L in the poplar stand and up to 6 mg/L in the Phragmites unit, which is neither anoxia nor hypoxia. Also median values indicate that dissolved oxygen is often above the hypoxia limit. Notice that anoxia occurs when the water is completely depleted of oxygen, whilst when oxygen concentration is less than 2 ppm the system is hypoxic (low oxygen content) – see page 3510, line 9.

3. The main conclusion that nitrates are denitrified is based mainly on relationship between pairs of variables. Are regression estimated from median, mean or original data? I tried to estimate the alkalinity to nitrate ratio from the regression line (please provide equations in figures 8 and 9), which is approximately 5, which means 5 equivalents of alkalinity/equivalent (mole) of nitrate? If so, there is an excess of alkalinity.

4. The hypothesis that bacterial sulphate reduction becomes dominant in the reed swamp is not supported by data. Probably fermentation and methanogenesis processes, rather than iron reduction, can occur mainly under high temperatures (see fundamental papers by Hans Brix). Under these conditions, nitrate could be processed through DNRA (back to ammonium).

5. The statement that alkalinity is a good indicator of redox conditions is questionable, not supported by data, and only based on assumption (see page 3516, lines 19-20). Nowadays, there are very suitable and relatively unexpensive analytical tools for measuring redox potential (needle and micro-electrodes).

Other comments

1. In the reed swamp there is a vertical gradient of chloride. Any explanation?

2. Plant-sediment interaction and sediment microzonation could be important in the reed swamp. For example in viable reed stands radial oxygen losses from roots could favour the formation of oxic microniche.

3. Lake-water ingression in the reed-swamp could contribute dilution of chemical species? Data on lake hydrology could shed light on this point.

4. DOC in the reed-swamp is not a good indicator of organic matter availability, since likely it is mainly refractory.

5. The statement at page 3516, line 21 is not logical. N2O is a product of denitrification only under certain conditions (low temperature, pH, etc). N2O is also an intermediate product of nitrification. The final product of denitrification is N2.

Minor points

1. Be consistent with units. My suggestion is to use only molar units.
2. Be consistent with symbols (NO2 does not make sense in this system, whilst N-NO2 should be used for nitrite)

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 4, 3501, 2007.