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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Carbon and nitrogen dynamics and greenhouse gases emissions in constructed wetlands: a review" *by* M. M. R. Jahangir et al.

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Response to the Referee's (Referee #1) Comments: MS. HESS-2014-272: Carbon and Nitrogen Dynamics and Greenhouse Gases Emissions in Constructed Wetlands: A Review

The authors are highly appreciative of the constructive comments and suggestions of referee #1 which have helped improve the manuscript

Comments: The review paper by Jahangir et al. on C and n dynamics in constructed wetlands (CW) does in general deserve to be published, but lacks some focus, which

needs to be addressed before publication. In particular I do not see what the sections 2 (physical and hydraulic properties) and 8 (N transformations) add to the paper. The properties discussed in section 2 are not connected to the C/N dynamics not the greenhouse gas emissions. Therefore, I do not see the benefit of including this section. As to section 8, this is largely a textbook-kind description of various N transformations (to be found in a multitude of textbooks) and no linkage to CW's is made. Therefore, I recommend omitting these two sections. Responses: Sections 2 and 8 have been removed as suggested by the referee.

Comments: In addition, Table 1 as well as Figs. 1-4 are very confusing and only to a limited extend informative. I therefore suggest omitting these as well are to significantly improve the readability of those. Responses: Table 1 and figures 1- 4 have been removed according to the referee's suggestion

Comments: Finally, it would be helpful for the readers if each section is ended by a sentence, summarizing the most important information. Most sections contain a lot of detailed information, which is why it is difficult to immediately grasp the most important information. The authors could help the readers by providing a summarizing sentence. Responses: We agree with the reviewer and as suggested a summarizing sentence at the end of each section has been added to make the manuscript easier to follow. The following sentences have now been added to the specified sections. âĂć Section 2. Removal Efficiency, Hydraulic Loading and Retention Time: In addition to the estimation of nutrient removal rates, investigation into the effect of HLR and HRT on the end products of the removed nutrients and their flows into the environment will help the better understanding of the potential for pollution swapping of CWs. âĂć Section 3. Accumulation of C and N in CWs Soils: Estimating nutrient accumulation in soil and subsoils and their in situ transformation rates over time are required to elucidate the fate of nutrients entering the system. âĂć Section 4. C and N Dynamics and Greenhouse Gas Emissions: Assessment of the reactive versus the benign forms of C and N transformation products in various CWs will give insights into their environmental

efficacy and management. âĂć Section 6. Hydrogeochemistry below CWs: Linking geochemistry of groundwater below CWs to site hydrology, water table fluctuations soil/subsoils physico-chemical properties and processes, is required to elucidate their potential for ground and surface water pollution.

Comments: All abbreviations in the text need to be defined, which is not the case at present. Responses: The abbreviations used in the text have been defined and used consistently throughout the paper.

Comments: p. 7616, l. 5: “removes N to remain in the system” sounds contradictory to me. Responses: P 7616 l 5: This sentence has been rephrased and now reads “There are many pathways for the removed N to contribute to water and air pollution: accumulation in the sediments, leaching to groundwater (nitrate-NO3- and ammonium-NH4+), emission to atmosphere via nitrous oxide- N2O and ammonia and/or conversion to N2 gas and adsorption to sediments.”

Comments: p. 7618, l. 2: IPCC (2014) not in reference list. Responses: P7618 l2: This citation has been added to reference list.

Comments: 7618, l. 16: “isotope tracing” is a more common used term. Responses: P7618 l 16: The word isotope-tracking is now replaced with isotope-tracing.

Comments: p. 7618, l. 25: maybe worth mentioning the potential for natural abundance (15N and 18O) studies to investigate the fate of N. Responses: P7618 l25: Suggested sentence has been added into the text “The studies of natural abundance of 15N and 18O (δN and δO) in NO3- can be an important tool to investigate the sources and fate of N in the system (Bailey et al., 2011).” References: Reference: Baily, A., Rock, L., Watson, C.J., Fenton, O.: Spatial and temporal variations in groundwater nitrate at an intensive dairy farm in south-east Ireland: Insights from stable isotope data, Agril. Ecosysts. Environ., 308-318, 2011.

Comments: p. 7619, l. 22: how can CH4 emission remove N? Responses: P7619 l 22:

Some words were missed here mistakenly. The sentence has been rewritten and now reads “For example, van der Zaag et al. (2010) measured CH4-C emissions as 0.2-27% of the total C removed and N2O emissions as 0.1- 1.16% of the total N removed in CWs.”

Comments: p. 7620, l. 1: what is meant by “good number of studies”? Based on Table 1 number of studies seems quite low. Responses: P7621 l1: This section has been removed which was suggested by the referee.

Comments: p. 7620 l. 10: suggest to start with an average number based on Table 2. In the following text more studies are mentioned. Why are those not included in Table 2? Responses: P7621 l10: An average number has been included into the text “On average, 50% of the added N can be removed by treating wastewater in CWs.” Some values cited in this section are now added to Table 1 where data are available in the literature (Vymazal, 2010; Mander et al., 2008).

Comments: p. 7623 l. 13-15: too detailed? Responses: P7623 l13-15: we have rephrased the sentences to improve its readability. Now it reads “In 0-0.15, 0.15-0.30 and 0.30-0.60 cm depths, mean total N concentrations were 685, 505 and 278 mg N kg-1; and mean NH4+ concentrations were 156, 151, and 28 mg N kg-1, respectively.”

Comments: p. 7624 l. 5ff.: this paragraph is not well structured. Some sentences are not well connected and the authors jump back and forth between topics. Please restructure the paragraph. Responses: Paragraph has been rewritten and now reads: “Processes involved in N removal and N transformations in wetlands include sedimentation of particulates (Koskiaho, 2003); nitrification, denitrification and DNRA (Poach et al., 2003; Burgin et al., 2014), microbial assimilation and plant uptake and release (Findlay et al., 2003), anaerobic ammonium oxidation (anammox) and DEAMOX (DEnitrifying AMmonium OXidation). Müller et al. (2014) developed a 15N tracing model, which was able to identify four different pathways of NO2- reduction to N2O: i) reduction of NO2- associated with nitrïiňĄcation, ii) reduction of NO2- associated with

denitriïňĄcation, iii) reduction of NO2- associated with organic N oxidation, and iv) co-denitriïňĄcation, a hybrid reaction where one N atom in NO2- originates from organic N and the other from NO2- reduction via denitriïňĄcation. Most of these pathways transfer Nr to the environment, mainly NH4+ and N2O. Some of these pathways however can convert Nr to N2 (e.g. denitrification, anammox and DEAMOX). In denitrification, NO3- is used as a terminal electron acceptor to produce N2 or N2O (Starr and Gillham, 1993). Anammox can remove NO2- and NH4+ as N2 in CWs as it is a hypoxic environment. The DEAMOX can remove NO3- and NH4+ as N2 where NO3- is converted to NO2- by autotrophic denitrification with sulphide (Kalyuznyi et al., 2006). Mander et al. (2008) estimated 19% of the total N input removed by denitrification in horizontal subsurface flow CWs. Obarska-Pempkowiak and Gajewska (2003) estimated 14% N removal of the total N input by plant biomass and soil matrix and assumed that the rest (86%) was lost by denitrification. Denitrification has been estimated to be a significant N removal process but actual quantification data are scarce. The two other processes that can remove Nr from the CWs (anammox and DEAMOX) are not well understood in this system. Hence study on these pathways in CWs will give insights into an improved N management towards lowering Nr in the environment."

Comments: p. 7624 l. 9: many of the before mentioned pathways transform one Nr species to another. So the term emit might be misleading. Responses: The word emit is replaced with the word "transfer".

Comments: p. 7637 l. 15: can you give examples for the "conservative tracer"? Responses: The example of conservative tracer has been added in the text- (e.g. Bromide- Br- and/or Sulfur Hexafluoride- SF6).

Comments: Legends for Tables and Figures should include used abbreviations. Responses: Used abbreviations have been included in legends for table and figures.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/11/C3774/2014/hessd-11-C3774-2014-

supplement.pdf

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 7615, 2014.