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Biogeosciences Discussions

Interactive comment on "Denitrification, carbon and nitrogen emissions over the Amazonian wetlands" *by* Jérémy Guilhen et al.

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On behalf of all the co-authors we thank the referee for the review and associated comments that helped us improve the manuscript.

The manuscript (ms) under review presents a new approach to estimate the emissions of CO2 and N2O from the various floodplains along the Amazon River during 2011 and 2015. The approach combines satellite data (-> estimate of the water surface) and in situ data with an empirical assessment of the nitrate reduction rate (i.e. denitrification) in the upper soil which in turn results in production and emissions of both carbon dioxide (CO2) and nitrous oxide (N2O). Although the presented results are of interest for a wider community, I have some concerns about the approach used for NO3- reduction.

Therefore, I can recommend publication only after major revisions.

Specific comments: "- The NO3- loss in the floodplains is solely attributed to denitrification. However, NO3- loss in soils can also take place during dissimilatory nitrate reduction to ammonium (DNRA) (see e.g. Rutting et al., Biogeosci, 8, 2011). So, I am wondering whether this could affect the estimate of CO2 and N2O emissions. Please discuss. You may need to adjust the equations (1) to (4) to account for DNRA. Please replace denitrification with 'nitrate (or NO3-) reduction' throughout the text."

In the current study, we consider the denitrification process during flood events. In these conditions NO3- is the limiting for both denitrification and DNRA. Moreover the DNRA contribution to N2O emissions is about 1% (Rüttin et al., 2011 from Cole (1988)) which is negligible considering the other sources of uncertainties at this scale. The environmental conditions for DNRA occurring (e.g NO3- limiting, high redox soil and high C/N) are not met in this case, thus the contribution of DNRA should be lower. Therefore, we are confident on our choice not to address the DNRA in this study. But this may be an issue that needs to be addressed for N2O budget at global scale in non-limiting conditions.

"- The amount of N2O produced is calculated with a constant N2O/N2 ratio of 0.1. You can do so but, unfortunately, there is no reference given for it (P6L22). Moreover, it should be discussed whether this ratio is constant or variable in the Amazonian wetlands. In other words, how representative is the selected value of 0.1? This is an important point because the choice of this ratio directly determines the magnitude of the N2O emissions and the variability of this ratio determines the 'error bar' of the N2O emission estimates."

We thank the reviewer for this essential comment that was discussed in the first stages of this work between co-authors. Indeed, a constant value of N2O/N2 can be argued and can be still accepted as mentioned by the referee. We actually based our estimates of this value from (Weier et al., 1992; Pérez et al., 2000).

We choose to keep a 0.1 ratio for N2O/N2 production. Our spatial resolution is coarse as we consider the flooded area over a 25 km x 25 km thus we don't take into account the landscape peculiarities. N2O/N2 ratio ranges from 0.05 to 0.2 and it is likely that several different ratios should be found within one pixel. Nevertheless, without any precise measurement on the actual ratio value and the different proportions we decided to set up an effective ratio of 0.1 (which is the most common for Amazonian wetlands : Pérez et al., 2000) for the whole watershed in order to not under/over estimate the emissions. In the manuscript, we only discuss about N2O values calculated from a 0.1 ratio (for better comprehension) but we added "error bars" corresponding to a 0.05 and 0.2 ration in the graphs. Comments in $ 2.4.1 P6 L20 and $ 4.5 P 17-18 were added to explain these choices.

"- I am wondering why nitrification as a source of N2O under low O2 is ignored. Please discuss."

Several studies showed that under anoxic conditions denitrification is the only source of N2O emissions (see Bollmann and Conrad 1998, Global Change Biology). The scoop of our paper is to specifically focus on denitrification and associated emissions, thus we did not take into account nitrification.

"- Title: Please note that the term 'carbon emissions' also includes emissions of methane and other C-containing gases which are not subject of the ms. Moreover, NO3- could be lost during dissimilatory nitrate reduction to ammonium (DNRA), see my comment above. To this end, I suggest to modify the title to 'Nitrate reduction and associated carbon dioxide and nitrous oxide emissions from the Amazonian wetlands'. "

We suggest to the editor a tittle change to"Denitrification with associated nitrous oxide and carbon dioxide emissions from the Amazonian wetlands"

"- The central and lower panels of Figure 6 are meaningless. They show exactly the same graphs but scaled with a factor of 5 (for CO2, see equation (4)) and 0.1 (for N2O;

N2O/N2=0.1). Please remove. "

Fig.6 was changed to represent N2O emissions over the basin and the floodplains. Comments in the caption and the text P9 L6-8 were added to explain that denitrification, CO2 and N2O emission follow the same patterns with different values.

"- Please avoid using colloquial terms such as 'paramount' (see P2L11; P4L2; P18L9) or 'hot moments' (see Section 3.1). They should not be used in the context of a scientific text. "

We understand the worries of the reviewer on the potential use of colloquial terms though it was not the intention of the co-authors. Concerning the term "hot-moment" : It was inspired from (McClain et al., 2003 Biogeochemical Hot spots and Hot Moments at the Interface of Terrestrial and Aquatic Ecosystems.): "A hot-moment corresponds as a short period of time with disproportionately high reaction rates relative to longer intervening time periods.". The term is also widely used in the literature. We choose to maintain it in the ms as it conveys our exact message. Concerning the choice of paramount : it has been replaced by "essential" or synonyms. Ex: During the last decade, process-based models have become key tools in estimating carbon and nitrogen budgets in the context of global multi-source changes. Future studies will concentrate in extending the current approach to other tropical basins, needless to say that local observations will be essential for the validation of such exercise and preferably over the same period of analysis.

"- Please have the text proofread by a native English speaker. There are many sentences and phrases which are odd. - There are several (annoying) typos: mole should read mol (various places throughout the text); 'og' should read 'of' in the caption of Fig. 5; N20 should read N2O (Fig. 5); 3rd column/2nd line in Tab. 1: there is something wrong with the exponent; 'anormalies' should read 'anomalies'(P13L15), etc. - Please replace NO3 with NO3- (in the equations as well as throughout the text and figures)"

The manuscript was thoroughly revised to improve the writing and to correct the typos.

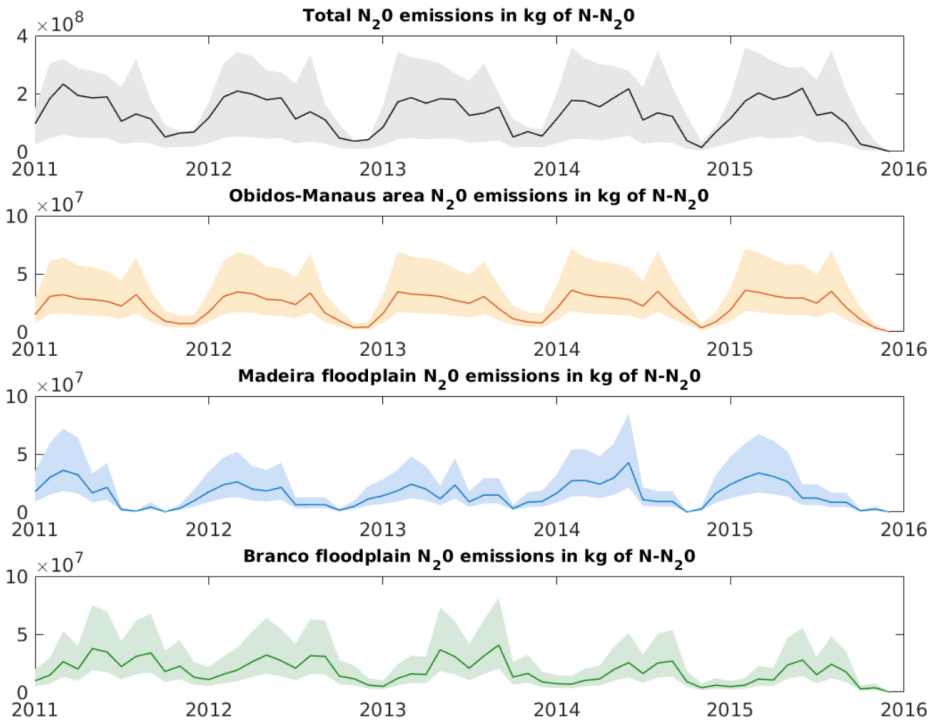
Total N_20 emissions in kg of N-N_20
$\times 10^8$
4
2
0
2011
2012
2013
2014
2015
2016
Obidos-Manaus area N_20 emissions in kg of N-N_20
$\times 10^7$
10
5
0
2011
2012
2013
2014
2015
2016
Madeira floodplain N_20 emissions in kg of N-N_20
$\times 10^7$
10
5
0
2011
2012
2013
2014
2015
2016
Branco floodplain N_20 emissions in kg of N-N_20
$\times 10^7$
10
5
0
2011
2012
2013
2014
2015
2016

Fig. 1.