Response #2

We would like to thank the referee for the constructive review of the manuscript. (comments in italics; responses in bold)

However, the study design and results may not relevantly reflect the background (frequent flooding by climate change) and the implication of the study. In my understanding, the enhanced CO_2 emission by flooding of the study was resulted from local hydrology and topographic factors (e.g., distance from the ditch) rather than regional climatic factors. The study design, LFS vs. SFS represented the different flooding regimes in response to topography, not climatic events. If the authors were interested in the interactions between CO_2 flux and flooding in response to climate change, authors could compare interannual differences of CO_2 flux. For example, at the level of interannual comparison, CO_2 flux in SFS during the period C, in which a prior flooding (period A) had occurred, was lower than that during the period E without prior flooding. In SFS, 2014 was more flooded year in response to interannual climatic variability; however, CO_2 emission was rather reduced in contrast to the authors' point of view. Therefore, I agree that "longer term flooding therefore increased, rather than reduced, the annual emissions by approximately 40 %" (P10 L19), in terms of the site hydrology affected by the topographical variation; whereas I reject that "any increase in freshwater flooding in response to climate change could result in a significant increase in carbon dioxide emissions from these systems" (P10 L20), according to the reduced CO_2 in SFS, 2014. The flooding related increases in CO_2 emission of this study could indirectly imply the relationship between frequent flooding by climate change and regional GHG budget, however, may provide little direct insights.

The reviewer correctly states that local hydrology and topographic factors explain the principal differences in hydroperiod between the two sites. However, the frequency, duration and spatial extent of flooding are highly dependent on the seasonal rainfall pattern, which is projected to vary with climate change. .

Given the complex interaction between the different drivers of GHG emissions, inter-annual site-dependent differences in the effects of flooding are not unexpected, as indicated by the reviewer. In the longer term, given an increase in flooding, more of the ecosystem will behave as does the LFS and the emissions are therefore likely to increase.

About methane……

Please refer to our response to the comment by referee #1

Was N_2O emission increased by the flooding? I could not find an evidence supporting the higher N_2O emission at more flooded condition.

There were no statistically significant differences in N_2O emissions between the LFS and SFS in any of the periods studied. However, we observed generally larger/positive N_2O emissions at the LFS during the second flooding period (period D).

There is no direct evidence supporting the changes in microbial population by flooding. The difference in Q10 values is a weak evidence.

The reviewer is correct that there is no direct evidence for this. An explanation for the different Q_{10} values could be because of the presence of different microbial populations and might be expected given the differing flooding regimes.

In my experience, at field, a hydric soil with low bulk density can be easily compacted by investigators who stand on the soil for measurement; consequently, the compaction can physically facilitate the gas evasion from the adjacent soil, resulting in biases in measurement. Have the authors considered this issue in the measurement?

It is true that gaseous emissions could be impacted through soil compaction and we minimized any disturbance to our sampling sites during the measurements.

Were there specific QA/QC procedures for the PAS analysis, such as calibration and maintenance?

The PAS was subjected to maintenance checks and calibration following the manufacturer's guidelines before it was used for measurements. The fine-filter paper was changed every 6 months and its holder at the back of the monitor cleaned using acetone and Q-tips as per the manual instructions. The filter pad in the ventilation unit was also washed regularly with water and soap. The calibration involved zero point calibration using pure nitrogen zero air, humidity-interference calibration using water-vapour, span calibrations using known concentrations of CO_2 (500 ppm) and N_2O (10 ppm), and cross-interference calibration.

Why were the annual CO_2 and N_2O emissions estimated for two pseudo different, mostly overlapped periods? I know the study only covered one and half year. Authors might attempt to provide inter-annual values. However, the two periods (Feb 2014–Feb 2015 vs. May 2014–Apr 2015) overlapped too much; therefore, the values in the two periods must be analogous. Why were the values from Apr 2015 to Aug 2015 excluded in the annual estimates?

The overlapping of the two periods is a consequence of our focus on the impact of inundation on the annual emissions on the inundation periods when we estimated the annual emissions. Including the period Apr.-Aug. 2015, as suggested by the reviewer, does not significantly change the annual emission we reported. If we include this period, the annual emissions are only reduced by 6% (34% rather than 40% increase).

P11 L17: I agree the substrate and nutrient loading by flooding could be a main driver of the enhanced CO_2 emission. However, I am not sure that the vertical profile of soil C and N could be an evidence for the statement. Could you provide references or another evidence supporting the higher surface soil C driven by external sources?

Evidence for higher surface soil C that is driven by external sources is given in: - Bai et al., 2005, Geoderma 124, 181-192; Bailey et al., 2007, Wetlands 27, p936-950; Winton and Richardson, 2015, Wetlands 35, 969-979.

Could the wet soils be sieved through a 2 mm sieve? In my case, wet soils for enzyme activity analysis were sieved through an 8 mm one. I assume a 2 mm sieve seems too fine to sieve wet soils.

We were able to sieve wet soil samples through a 2mm sieve after temporarily leaving the cores to drain. We also manually disintegrated soil aggregates to facilitate sieving. The reason why we were able to do this could be because of the high sand content of the coastal soil at this site.

I am not sure whether the water depth could be a relevant independent variable for CO_2/N_2O modelling because the water depth data are available only for flooding period in the LFS. In other words, even in the LFS, the relationship between water depth and CO_2/N_2O does not cover the high CO_2 emission during the growing (temperature higher than 15 ^0C), non-flooded (water depth lower than zero) season.
As I already mentioned, relationship of CO_2 to water depth is only limited during the period when CO_2 emission was not intensive. In addition, "most of this variation is explained by changes in water depth alone" is it true? Soil temperature also explained 56% of variation in CO_2. The 62% of the explanatory power for temperature and soil water depth dependent model and the 45% of explanatory power for the soil water depth dependent model do not mean the small explanatory power for the temperature dependent model. I suggest that the soil water content may substitute the water depth of the model.

We concur that water depth cannot be an independent variable for modelling the annual fluxes as flooding was restricted to a limited period of the year at the LFS. To clarify, the relationship between water depth and CO_2 emissions was only examined during periods of standing water (periods A, B and D). For these periods water depth was the major factor underpinning the emissions, as indicated by Fig. 8. Soil moisture during these periods was largely invariant. As discussed in the paper soil moisture (R^2 = 0.52) and especially temperature (R^2 = 0.56) were the major drivers for CO_2 emissions over the whole study period.

The dependence of CO_2 emissions on soil temperature is generally observed in thousands of soil CO_2 studies and unquestionable today. I think the discussion can be shortened. In addition, Q10 can be an indicator of the sensitivity to climate change; however, the Q10 values from exponential regressions with the low goodness of fit might not be reliable indicators.

We can shorten the section about temperature if this is considered to be too detailed. Although there was a low goodness of fit for estimating the Q_{10} values, which is perhaps not surprising given that they are based on field measurements, the differences were significant and support the suggestion that the longer-term flooded site could be more responsive to future increases in temperature.

Could the growing vegetation directly uptake N_2O? Please provide an evidence or reference.

As far as we know, there is no convincing evidence that plants take up and assimilate N_2O, instead relying mainly on mineral forms of N (ammonium or nitrate). Growing vegetation consumes available inorganic nitrogen in the soil, and this could reduce the amount of inorganic nitrogen available for conversion to N_2O. There is a large body of evidence that shows that N_2O emissions are often closely associated with nitrate availability in soils. Low NO_3^- availability might also facilitate N_2O uptake with N_2O, rather than NO_3^-, acting as the major electron acceptor in denitrification reactions (e.g. Wagner-Riddle et al., 1997).

Tables 1 and 2: Present statistical differences in the variables between the two sites and standard errors, too.
Figure 1: I suggest adding photo for flooded and non-flooded period of the LFS and SFS.
Figure 4: Is the soil water content volumetric or gravimetric?

Standard errors will be provided in the corrected version of the manuscript. The soil moisture values reported in the manuscript are volumetric. We can also include a photograph of the site if required.

Relationships between CO_2/N_2O fluxes and environmental variables (e.g., soil temperature, soil water content, water depth, redox potential, and probably microbial variables) could be presented in a table with various simple linear, multiple linear, and nonlinear regressions.

All tests for the relationship between the measured variables and N_2O emissions were not statistically significant and were not presented (as explained in the text). The relationship among the measured variables and CO_2 emissions are reported in the text. These could be repeated in a table if required.