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Interactive comment on "Effects of two contrasting biochars on gaseous nitrogen emissions and intensity in intensive vegetable soils across mainland China" *by* Changhua Fan et al.

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Dear Reviewer #1: Thank you very much for your great support and critical comments. Those comments are all valuable and very helpful for revising and improving our paper, as well as further important guidance for our researches. We have made corrections which we hope to meet with approval. Please see the following point-by –point answers and the suplementary file of manuscript with tracking system for your further evaluation.

1. Thank you for your nice comments! The main reason is that N2O production and mitigation in different soil type was governed by different processes. It's applicable to

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SX and HLJ but not HN soil. There were no significant relations between N2O emissions and DEA in HN soil (Table 4), which indicated that denitrification was not the main process for the N2O production. Many researchers had reported that some other processes such as heterotrophic nitrification (Zhu et al., 2011; Cai et al., 2010), nitrifier denitrification (Zhu et al., 2013) are the main pathways of N2O emissions especially in the soil with low pH, low carbon content and high mineral N content (Wrage et al., 2001), which greatly match the soil properties of the vegetable soil from HN. Thus, due to the complex potential pathways in HN soil, the lowest DEA activity might influence but not determine the magnitude of N2O emissions in HN soils. Cai, Y.J., Ding, W.X., Zhang, X.L., Yu, H.Y., Wang, L.F., 2010. Contribution of heterotrophic nitrification to nitrous oxide production in a long-term N-fertilized arable black soil. Communications in Soil Science and Plant Analysis 41, 2264-2278. Wrage, N., Velthof, G., Van Beusichem, M., Oenema, O., 2001. Role of nitrifier denitrification in the production of nitrous oxide. Soil Biology and Biochemistry 33, 1723-1732. Zhu, T., Zhang, J., Cai, Z., 2011. The contribution of nitrogen transformation processes to total N2O emissions from soils used for intensive vegetable cultivation. Plant and Soil 343, 313-327. Zhu, X., Burger, M., Doane, T.A., Horwath, W.R., 2013. Ammonia oxidation pathways and nitrifier denitrification are significant sources of N2O and NO under low oxygen availability. Proceedings of the National Academy of Sciences of the United States of America 110, 6328-6333. 2. Thank you for your comments! The other processes that related to the N2O or NO emissions might be nitrifier denitrification and heterotrophic nitrification. We discussed more about the other processes that related to the N2O or NO emissions on Page 13 line 14-18. Specific comments: 1. The NH3 volatilization result affected by biochar and soil types is not mentioned in the abstract. A: Thank you very much for your comments! Biochar amendments generally stimulated the NH3 emissions with greater enhancement from Bm than Bw. We added these results on Page 3 line 14-15. 2. Line 19, "Bm improved yield. . .except for HN," but the increment in SX is also not significant. A: Yes, you are right. Bm improved yield by 13.5–30.5% (except for HN and SX).We have revised it on Page 3 line 12. Thank you! 3. Line 30, According to IPCC 2013, the global warming potential of N2O is 265 times of CO2 on a 100-year horizon. Please correct the data. Line 393-394, please modify. A: Thank you! We have corrected the data 298 by 265 on Page 4 line 6 and modified the corresponding citation on Page 19 line 19-20. 4. Line 111, the experiment was conducted in the greenhouse experimental station, so how to use completely random design? A: Sorry for the inappropriate descriptions! Before the trial, we labeled all the pots, and then distributed them by casting lots in the experiment region. We have also deleted the world “completely” to make it more appropriate on Page 7 line 8. 5. Line 255-257, could you maybe give some explanation for why a neutrality pH soil will cause mitigation effects of N2O emission? A: Thank you for your comments! As reported before, N2O is produced during several N2O production pathways and its release to the atmosphere is almost entirely controlled by microbial activities. Among all the pathways, denitrification has been approved to be a main process in upland fertilized soils (Cheng et al., 2015), especially in vegetable field (Qu et al., 2014). As was shown in Fig 1b, Biochar amendments significantly decreased DEA in neutrality pH soils (SX and HLJ), which cause mitigation effects of N2O emission. However, biochar did not reduce the N2O emissions in acid and alkaline soil. Soil pHs lower than 5 can adversely affect the activity of nitrous oxide reductase (Liu et al., 2010) and biochar application could not consistently alleviate the adverse effect of such acid pHs. Additionally, nitrification would be the main N2O production pathways, and biochar amendment stimulated nitrification which could increase the N2O emissions in alkaline soil (Sánchez-García et al., 2014). Therefore, biochar amendments might have promising mitigation effects through altering the DEA in neutrality pH soils, in which denitrification tends to be the main N2O pathway. Cheng, Y., Wang, J., Zhang, J. B., Müller, C., & Wang, S. Q. (2015). Mechanistic insights into the effects of n fertilizer application on N2O-emission pathways in acidic soil of a tea plantation. Plant and Soil, 389(1), 45-57. Liu, B., Mørkved, P.T., Frostegård, Å., Bakken, L.R., 2010. Denitrification gene pools, transcription and kinetics of NO, N2O and N2 production as affected by soil pH. Fems Microbiology Ecology 72, 407-417. Sánchezgarcía, M., Roig, A., Sanchezmonedero, M.A., Cayuela,

M.L., 2014. Biochar increases soil N_2O emissions produced by nitrification-mediated pathways. Frontiers in Environmental Science 2, 25. Qu, Z., Wang, J., Almøy, T., & Bakken, L. R. (2014). Excessive use of nitrogen in chinese agriculture results in high $N_2O/(N_2O+N_2O)$ product ratio of denitrification, primarily due to acidification of the soils. Global Change Biology, 20(5), 1685–1698. 6. Line 293-299, please only discuss significant effects. No significant reductions of NH_3 volatilization were found in this study, NH_3 volatilization increased after biochar applied though the effect did not significantly. So I think the discussion of how the biochar reduce NH_3 volatilization is not necessary. And your interpretation of the results includes a lot of over speculations that cannot be logically derived from the results. A: Yes, you are right! We deleted those speculations about the mitigation of NH_3 emissions on Page 14 line 17. Thank you! 7. Line 304-310 and Line 311-318, should change place. A: Thank you! We have exchange lines on Page 14 line 22-30 and Page 15 line 1-6. 8. Line 324-326, this is a lengthy sentence that could be maybe divided into two parts. Please split the sentence between "Additionally. . .vegetable yield". A: Thank you! We revised the lengthy sentence on Page 15 line 12-14. 9. Line 326-328, the two sentences are dispensable. A: Thank you! We have deleted the two sentences on Page 15 line 14. 10. Line 331-332, the conclusions of this study are either flawed. i.e. N_2O and NO in SD show no significant changes among all treatments, and the conclusion cannot be drawn from your results only. Please modify. A: Yes, sorry for the inconvenience! We have modified the descriptions that biochar amendments generally reduced N_2O and NO emissions (except for SD soil) in conclusion on Page 16 line 2. 11. Page 19-22, all the tables should be three-line tables. A: We have revised all the tables on Page 24-27 and Page 3 in the supplementary material. Thank you! 12. Page 24-27, it is better to use the same y-axis scales in the same figure. A: We have revised the figures on Page 30-32.

Thank you once again for your great support and comments!

Sincerely yours, Zhengqin (on behalf of all authors)

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Biochar can decrease the gaseous reactive nitrogen intensity in intensive vegetable soils across mainland China

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1

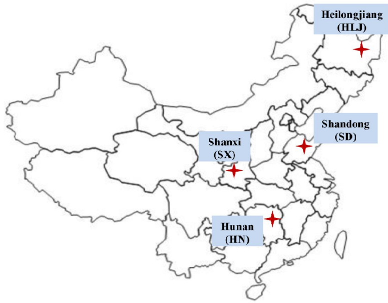
Fig. 1. revised manuscript with figures

Supplementary information

Fig. S1 Map showing the sampling sites in China.

Fig. S2 Dynamics of water filled pore space (WFPS), air temperature and soil temperature during the vegetable cultivation period.

Fig. S3 Scanning electron microscope (SEM) images of the biochars derived from Bw (a, b and c) and Bm (d, e and f). Same magnification for a and d (× 50), b and e (× 400) and c and f (× 2000).



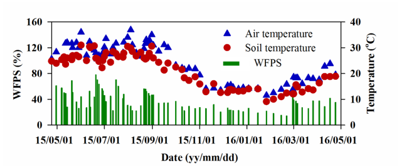


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Fig. 2. revised supplementary

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1

Fig. 3. with tracking system