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Interactive comment on “Effects of mowing on N₂O emission from a temperate grassland in Inner Mongolia, Northern China” by L. Zhang et al.

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Received and published: 17 February 2014

Abstract Line 10: "control of non-mowing"→ Not clear if this is ungrazed or used as grazing land in any manner. Please shortly give a hint.

Response: The experiment site is a fencing field and we explained it at P19224, L3-4. "Prior to the setup of the experiment, the site had been kept free from disturbance and large animal grazing by fencing since 2001." And we changed it to "a control (non-mowing)" in our revision.

General: Highest N₂O fluxes were recognized during freezing-thawing periods, especially after snow melt (March/April). In your experiment these fluxes were ignored: The paper, cited also in this manuscript, Wolf et al 2010: "In temperate ecosystems with

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long frost periods, distinct freeze–thaw periods can occur. These periods can contribute significantly to annual N₂O budgets : : :” and Figure 1 in Wolf et al. 2010. Check also Essery, R. & Pomeroy, J. Vegetation and topographic control of wind-blown snow distributions in distributed and aggregated simulations for an Arctic tundra basin. J. Hydrom.5,735–744 (2004) as cited in Wolf et al. 2010: “Vegetation height is the determining factor in snow-holding capacity, such that snow is more quickly eroded at grazed sites with sparse or low vegetation than at sites with denser and taller vegetation”

Response: Thanks for your constructive suggestion. We also regret that we did not account for snow and freeze-thaw events, which will likely result in an uncertainty of the estimate of N₂O fluxes, in this study. We talked about it in the Discussion of our revision. Given the importance of the effects of snow and freeze-thaw on N₂O fluxes, we will extend and intensify our measurements over four seasons in the future research.

Line 23-24: To define grassland as a sink, year round measurements are necessary!

Response: We deleted this sentence.

Introduction: The variation of grain size distribution seems to be too small. Taking units of two decimal numbers (.00), also for pH, is pseudo precise. How many samples were chosen? Methodology of grain size distribution? Are these data published somewhere else?

Response: These data are cited from Xia and Wan (2009). Xia J, Niu S, Wan S (2009) Response of ecosystem carbon exchange to warming and nitrogen addition during two hydrologically contrasting growing seasons in a temperate steppe. Global Change Biol 15: 1544–1556.

Methods

Soil moisture and temperature measurements: It is not clear if both values were measured weekly/biweekly or permanently. If weekly/biweekly: Both values are highly vari-

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able in space and time, especially after rain events and snow melt (moisture), during day/night, cloudy sunny weather (temp). It is not clear which daytimes measurements were made. Taking average values and “ranges between” and reporting “highest values in July” (moisture) in the result section are not correct as rain event shortly before measurements (moisture) or varying time of date measurements (temperature) would influence the results.

Response: Both values were measured weekly/biweekly at the time of N2O sampling, please see P19224, L 21-25. Therefore, the “ranges between” and “highest values in July” only represent the data we caught but should reflect a general trend of soil moisture and temperature, since we carefully choose similar daytimes (9:00am - 12:00am) and typical weather condition to collect samples and measurements.

3.1 Was there really no snow fall between Nov and Feb in both years? Usually you have a permanent snow cover in this region between November and March.

Response: Fig. 1 shows the rainfall of the two years. And there was a permanent snow cover in this region between November and March, but we did not measure the snowfall because we presume that the snow has little effects on N2O flux of growing season. .

3.3/3.4. In my eyes it is not entirely correct to call single measurements “means over the growing period”. Again, values are highly related to precipitation, time of the day, day-night cycles, cloud-shadowing: : :. I recommend using measurements as single values/trends and moving interpolated data from hour measurements to season-averages into the discussion section.

Response: We did not call single measurements as “means”. And here the “means over the growing period” is calculated over a whole growing season.

3.3. Line 23 “Figure 3 indicates that grasslands: : :” is not right. Better: “Measurements showed that grassland could be a sink/source (Figure 3)”

Response: Accepted.

3.3. “surprisingly” is does not look so good in the result section – Better write and explain why it surprised you in the discussion section.

Response: Done, please refer to P19230, L8-23.

Figure 4a: Soil moisture 9-15% seems to be much too high in the semi-arid region. I guess it is permille (?) If so the measurements have been made under more or less comparable conditions (not directly after snow melt or after rain fall). What is to be expected after such moist conditions (e.g. short time water saturation)?

Response: Thanks. Yes. The unit of the soil moisture is V/V%, and we revised it in our revision.

Figure 4f: I cannot see the “open circles” in the figure. If there is a temperature effect it would be better to show this effect instead of separating some measurements. However there seem to be a multiple effects on the N₂O fluxes.

Response: Thanks. And we deleted the regression in the Fig. 4f and did not separate the measurements in our revision.

4.1. First sentence: : : :decrease in N₂O >emission< : : : (the word emission is missing)

Response: Added.

Line 21/22 twice “this was in a line with : : :” The Discussion section is convincing and compliant but it also agrees with my critical points above “Because moisture is the key determinant of the microbial processes that consume or produce N₂O, soil moisture shifts in arid and semiarid regions will likely affect N₂O fluxes”. I strongly recommend the authors to show, that measured were performed only under dry conditions and that short wet conditions have great effects on N₂O fluxes but were not included to this study. This is the reason why no analyses of a entire seasonal balance is possible.

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Some ideas in this direction I miss in the discussion: : :: Reducing plant height could increase solar radiation on the soil surface (+evaporation) and dryer conditions. Long grass also catches snow, rain and morning dew! increase of local soil moisture.

Response: Thanks. We revised the paper following your suggestions.

Figure 5: the y-axis is not clear to understand. What is meant by minus X% moisture? Relative reduction? Over which period or is this the seasonal average?

Response: The y-axis is changes in the N₂O fluxes (mowing treatments against control) while the x-axis is changes in the soil moisture (mowing treatments against control). Yes, this is the seasonal average.

Interactive comment on Biogeosciences Discuss., 10, 19219, 2013.

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