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Interactive comment on "Drainage reduces CO_2 uptake and increases CO_2 efflux by a Siberian floodplain due to shifts in vegetation community and soil thermal characteristics" *by* M. J. Kwon et al.

Anonymous Referee #1

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The manuscript by Kwon et al. reports on two years plus some historical data of carbon dioxide flux measurements made in a tundra wetland in Siberia. Thereby, the authors compare a natural wetland with a drained site, which are in near proximity of eachother. Such "paired" sites are rare and strongly needed to further understand carbon dioxide exchange of tundra ecosystems. Moreover such experimental manipulations as shown in this study are rare and difficult to setup in remote regions, while being of extraordinary importance to understand ecosystem functioning under ongoing climate change. Therefore the represented manuscript is of great interest for the readers of Biogeosciences. Unfortunately, the authors present carbon dioxide fluxes only,

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whereas methane fluxes are likely to contribute considerably to the total carbon budget of this type of ecosystems and methane can easily become the game changer as already suggested in previous study at the site a decade ago. Still, the analysis based on the vegetation mixtures as well as ER, GPP and NEE provides a valuable contribution which has not been covered in previous studies. Besides the currently presented science and given the fact that the author list includes native English speakers and Senior scientists it seems like not all co-authors have read the manuscript or provided input. If done so the readability of the paper can clearly be improved and would fulfill minimum scientific standards – especially in the discussion section. This must be done in order to have the manuscript considered for actual publication in any journal.

Please find other major comments and a list minor/technical comments, which should be taken care of by the authors prior to possible publication in Biogeosciences.

Major Comments: (1) The manuscript structure needs to be improved in terms of avoiding mix-ups between site, location, transect as well as why certain places were characterized by high WTD even though being located in a drained area. You need to explain why such patterns occur and why you decided to separate these. (2) Furthermore when you investigate component fluxes it remains unclear why the authors once use the vegetation composition as main driver variables why for ER only WTD was choses as primary driving variable. Since both component fluxes are interlinked as well as species composition depends on WTD I suggest to find a common ground, in other words combinations of species mixtures and WTD and then look at the individual fluxes. (3) It remains puzzling why the other present 20 and 66day cumulative CO2 fluxes in the manuscript. Such cumulative numbers are for two reason not comparable to other sites: (i) providing a mean or a cumulative average for such a period in mole and (ii) the integration period is not the same for the two year and does neither represent a year or a specific season. I suggest instead of presenting cumulative sums to clearly look at the processes and driving factors since there seems to be quite some potential in the dataset to do so. (4) The discussion needs substantial improvement

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concerning structure, scientific argumentation as well as concerning the logic. There are few reference but too often restating of results.

Minor /Technical Comments:

P2,L27: I think the final sentence is not clearly representing your results. You have both a Pro and a Con result so far from the 2013 and 2014 data. Why would this lead to the current conclusion? P2,L33: until which soil depth and what is your definition of the Arctic? P2,L41: delete “that is currently stored in deeper” P2,L42: please try to be specific: Arctic ecosystems or ecosystems in the Arctic. The Arctic is not an ecosystem you may refer to it as a biome or geographical zone P2,L44: What about radiation and nutrient supply – both crucial factors in the Arctic too – especially since you mention PAR in your figures P3,L49: why complex? Indeed this may lead to changes but what makes it so complex, try to be more specific P3,L52: One could add an objective here again, otherwise this is all nice information but the reader does not yet know why this background is important P5,L91: Which conclusion do you draw from your introduction? My suggestion would be to state the need for more studies needed, paired design studies, extrapolation to models according to x,y,z P5,L92ff: this is important but seems a bit lost here - can you incorporate this information at the beginning of the previous paragraph? P5,L97: depends on how you define short-term – the historic data refers to four growing seasons of measurements including one experimental season. How about " an initial hydrological manipulation a decade ago” since you have two season only and can hardly use this as a long-term study. P5,L98: “This study investigates. . .” P5,L104: There hasn’t been much on frozen season information been provided in the introduction but one of your foci is particularly on frozen season fluxes. Therefore I suggest to expand towards this topic a bit.

P6,L112: you state “annual mean” – for which year or which timeperiod is this provided P6,L115: According to the previous papers on this site, the spring flood occurs occasionally. Was this the case for both years of observations? P6,L115: You refer to water table depth even though the water table is above the soil – it’s a bit contradicting since

this does not refer to a depth but rather to a height P6,L116: To which period are you exactly referring to with “early growing season”? Can you specify this – see also the comment to Figure 5 P6,L117ff: please rephrase: Periodic fluctuations approx.. every 5 years but no persistent long-term in air temperature and precipitation could be identified when investigating meteorological data since 1980. P6,L120: remove the “of” before 2004 P6,L120: can you please clarify what you mean with “ water from the surrounding are”. Surrounding what? And what were the effects was only the inner area of the drainage ditch as seen in Figure 2 drained or also the outer area? P6,L123: how do such short term fluctuation occur? P6,L125: this is an objective and a statement that has been given before – please avoid redundancies and move objective from the methodology section to the introduction P6,L127: is that the previously drained site or an new drained site? P6,L129: How did you estimate that this area was not affected? P6,L129: try to avoid a mix up of the term site and plot/sampling location. I assume you are referring to plots at the two subsites or the one site in Chersky, depending on the fact whether you have seperate experimental fields for instance or other criteria P7,L133: How do you define representative vegetation? Representative for what? P7,L133: “small enough. . ..” – does that bias your measurements/results? P7,L134: I suggest to rephrase the sentence towards: “Our analysis comprises the analyis of x weeks of y during .... P7,L136: you may delete the full sentence P7,L138: repharse to: Subsites and plots are labeled according to. . .. P7,L145: What about soil temperature and soil water measurements in the chamber as well as frozen or not frozen status? P7, L145: Did you test the chambers to avoid Venturi effects? P7,L152: which should then equal ER, correct? To my opinion is should be dark during the frozen time most of the time anyway P7,L155ff: very good and I can imagine how much work this must have been in this region P7,L159: please correct throughout the whole manuscript: μmol m-2 s-1 instead of μmole P8,L159: I suggest to add a citation of a typical chamber flux calculation paper P8,L169: what do you mean with nearby location? P8,L172ff: Why on dry biomass, if you have very “fleshy” plants they could have a larger realistic contribution to the overall biomass then drier plants but if you base this on dryweight

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only, the effect might disappear P9,L179ff: this is unclear. also, how do the two different methods compare? P9,L182: Write full words in the heading P9,L187: data are always plural P9,L189ff: phrasing is incorrect – I assume that the coauthors that are native speaker could solve this issue. Just as a side note, one could easily reject a paper due to such “technical errors”. At the moment it is rather an obvious sign that not all co-authors have fully read the manuscript. P10,L204: why does this approach make it better to compare with 2013 data? P10,L205: can you name these pre, peak, post season and can you do this similar in all papers originating from this research P10,L207: why august? P10,L210: Please replace “to find out” with “To investigate” P11,L218ff: This is very confusing, please simplify P11,L223: what do you mean with -1 . GPP? P11,L236: . . .from sensors installed in “the” chamber system. . . P12,L239: how did you optimize, via bootstrapping methods? P12,L247: please remove “equation” P12,L249: measurements P12,L251:. . .. temperature from the meteorological station P12,L254: insert “,” between 2104 and while P12,L254: numbers below eleven are commonly given in words P12,L255: please change to Carex sp., Erophorum angustifolium. . .. P13,L266: wording P13,L267ff: name the other terms P13,L269: How did you add both error term? P13,L270ff: how many and why? P13,L274: time statement goes usually to the end of the sentence P13,L275: please explain since these are two antagonistic fluxes. were both fluxes low or large but equal? P13,L275: please refer to Figure 3 here and for Figure 3 I suggest to state very clearly that one panel is based on 2013 data only and one is 2014 data only! P13,L279: . . .2014. However... P13,L280: but this happened at both sites? P15,L304ff: please simplify. I also wonder why you treat vegetation structure independent from WTD and TD even though these are obviously linked P15,L312: That is something that could be indicated in your Figure 1 scheme and make the whole story much clearer P15,L318: well done, but why do you give r values and its sufficient to show the numbers either in the figure or the text but there is no need to repeat these P15,L321ff: Fine, but what does this tell us? P16,L326: you might want to consider stating this slightly different-take the maximum uptake as 100% and then just give with > CarexShrub (how many of 100% remained) would there be a

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difference between CarexEriophorum and EriophorumCarex? Meaning does the order of the names mean that the first was more abundant? your abundance was based on the 10% criterion, so there were no plots with all three plant species? P16,L329: here I suggest a bar diagram, so that the reader is able to follow. P16,L332: I suggest to not jump between drained and undrained an veg. groups - one after another P16,L339ff: This is redundant P16: I suggest to find a way, to simplify the drained undrained and species mixtures.... see also the comments given to the figures P16,L343: soil temperature effects of what? P17,L344: why do you explain one Variable with vegetation primarily and the other component with WTD even though both are linked? P17,L349: Table, Figure? P17,L355ff: I have three general comments here. I think its better to focus on the actual results instead of doing an error analysis, discussion first – this can be done either in the methodology or in the discussion. Secondly you do not have too much data to do a robust gap-filling and base results on the gap-filled data, therefore I suggest to stick with the measurements primarily. Also you provide cumulative flux values for 20 days in 2013 and 66 days in 2014. How relevant are these or how do you suggest one should set this in perspective to other studies? My suggestion would be to remove this part or if this is not possible to focus on specific season and also keep same time intervals in both years. Last but not least cumulative fluxes should be given in g C or CO2 m-2 per time interval not in μmol to allow comparison. P18,L376: PAR was excluded.... P18,L373ff: if the model considered vegetation type then of course you will find the same effect as before. Please clarify P18,L378: 0.3μmol m-2 20days – that's basically nothing and your overall uncertainty of the approach is larger. P18,L381: how can these be similar- can you calculate the fluxes also for a time period of 20 days? so that they become comparable to 2013? please give g C since μmol do not make sense for cumulative fluxes Furthermore I wonder what the key message is if you present 20day or 66day cumulative fluxes. How shall these be compared to other studies, annual or growing season estimates would be much more relevant. P18,L385: When were these observed? P19,L387: replace "by" with "of" P19,L387: rephrase to "emitted on average four times more CO2 than the undrained site." P19,L393: Can

you authors state why this is the case? P19,L397: how large was the variability, if its too narrow anyway then why would one test it? P19,L398: I think you could provide this amount of information in a brief table or add it do an existing table. P19,L406ff: the mixing of the two sites and the individual sub-locations which are either wet or dry is still very confusing and I suggest to clearly explain this in the beginning but also make this always clear for the whole manuscript. P20,L409: What is "low WTD of undrained_low. . ."? P20,L411: Which do you think a location with a low water table in the drained area is quickly affected by precipitation? Isn't that contradictory to your experimental setup where you have a drainage channel to actually drain the water? P20,L412: Do you have a reference proofing that Eriophorum is capable of achieving such water holding? P20,L414ff: this is unclear, please explain and clarify P20,L417: please delete this paragraph. P20,L421: Here you state it's a clear vegetation effect but I suggest to argument differently. You introduce a disturbance such as drainage and this has a follow-up effect e.g. on vegetation and then subsequently the carbon fluxes are affected. Please make sure you have a clear logic in your manuscript. P20,L423: replace "died out" with "extinct" P20,L425: That is a very precise result and I wonder how you can determine this so accurately. The following sentence contain the same information, please avoid redundancies. ". . . with larger shrub abundance in the future." P21,L435: Appendix 3 – consider that some of your figures will be available in b&w only.The currenty color choice makes it impossible to see the error bars P21,L436: ". . . was a reduced abundance of. . ." P21,L438: Please explain why a site that contains Eriophorum will have an even larger decrease in GPP compared to the Carex while you state before that Eriophorum is so productive compared to Carex. This is contradictory. P21,L440ff: Is there any proof for your hypothesis? References are fully missing? Also try to avoid restating results P22,L451: prevalence -> occurrence P22,L455: Can you estimate how much lower the CO2 flux could be? What is the picture of your results? P22,L459: That is the first time you mentioned Rh specifically, Why were there no specific results on this part presented in the results section? P22,L462: soil surface temperatures instead of surface soil temperatures P23,L481: Where did you find the

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Rh increase in your results?

Figure 1: Even though the authors do a great job in bringing up such scheme about the experiment it seems incomplete. What are the fluxes before drainage and I suggest to modify the size of the arrows to see what you hypothesize. Other effects such as vegetation effects are not visible here. The Figure caption refers to a drainage event. When reading the manuscript this seems not to be an event. I also suggest to use the same terms as used in the text for photosynthesis and ecosystem respiration (GPP, ER) and to include NEE.

Figure 2: this is not a schematic but an aerial photograph. How about: Aerial photograph of the site with the schematics of the drained and undrained transects. Names of observation locations are indicated with numbers and the core locations are highlighted in yellow. - I further suggest to explain what core locations are and what was observed at the sampling locations briefly since the figure should be fully self-explanatory without the manuscript text

Figure 3: I suggest to highlight the year for the various panels as well as to indicate the wet and dry locations in the respective transects, since this particular issue may lead to lots of confusion. What are “relative terrain heights”?

Figure 4: Why not providing common boxplots? Figure caption: Abundance of ... Betula exilis, Eriophorum angustifolium etc...

Figure 5: I suggest to the subseasons by name instead of 2014.1 etc.. Why did you choose the exponential interpolation approach? Also name the subseasons in the Figure caption

Figure 6: this is very well explained in the text and I suggest to bring this issue up at an earlier point in the manuscript, since this proofs the concept of your experiment and by these structural changes an influence on the CO2 fluxes becomes relevant.

Figure 7:I suggest boxplots instead of the clouds

Figure 8: Consistently explain the length and a name for the subseason throughout the manuscript

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