Review of "Impacts of climate variability on wetland salinization in the North American Prairies" by Nachshon et al.

General comment:

The paper by Nachshon et al. presents analysis of the field measurement data from the case study in the Saskatchewan, Canada to explore temporal salt dynamics in prairies, assuming that pond processes are an adequate equivalent for analysing the system behaviour under climate change. The main result of the work is the clear evidence of the different system response to wet conditions associated with snowmelt and rainfall. While the significant snowfall does not induce any significant changes in pond salinity, intensive summer rainfall triggers processes that contribute greatly to the changes in salinity values, with potentially significant implications for local community and ecosystems. The manuscript is very well written, and my only comment considers the clarity of presented results. While the data sources and analysis are presented in details, I was struggling to follow the story, with different ponds and years used in different analysis. Finally, although the results show clearly the unresponsiveness of the salt pattern to increased snowmelt, the clear justification for this conclusion is not given. As such, I find that the manuscript would be suitable for publication if the authors would address a few minor comments discussed in more detail below.

Specific comments:

Page 13476, Line 14: In the rest of the manuscript, as well in the data analysis, you mention and use a period of 20 yr of observations, though one plot is shown for the period of 40 yr (Fig. 4). For the clarity of the paper, and since you mainly use the data from 1993 onwards, I would suggest that you change the sentence to "… taken over the last 20 yr", and present Fig. 4 using the same time range. That way the temporal changes of the pond depth that you are explaining in the text would be more perceptible as well.

Page 13476, Line 20: Please indicate what is your explanation why the wet conditions associated with high snowmelt do not pose a threat to salinization. The statement that it is your conceptual understanding of the system is quite vague.

Page 13478, Line 1: I would like to see few sentences explaining briefly the conceptual representation of salt dynamics from Nachshon et al. (2013). This would give insight into salt dynamics you are trying to capture with experimental data analysed in this work. Finally, I think you should come back to some of the findings in 2013 paper when explaining the results presented in this manuscript (please see comments Page 13476, Line 20 and Page 13490, Line 3).

Page 13478, Line 12: I think the manuscript would be easier to follow if here you would give a brief description of the analysis you will undertake, emphasising that you will be starting with the field scale analysis, followed by looking at a specific transect and finally finishing with small scale (single pond) analysis.

Page 13479, Line 5: A table summarising available data, corresponding locations, period and frequency of acquisition would, I think, contribute greatly to following the results presented (e.g. Precipitation / 35km of St Denis site / 1993-2012 / daily?).

Page 13479, Line 8: Please add location of the climate station to Fig. 1A.

Page 13480, Line 4: Please add the information where you obtained the data for the pond depths presented in section 3.1.

Page 13482, Line 22: Why some of the ponds used for water level analysis are different than ones used in section 3.2 for salinity analysis? It would make sense that you use the same ponds for field scale analysis, as you are trying to correlate the water levels with pond salinity.

Page 13482, Line 26: Please explain why you have chosen the normalised water level of 70% as representative for wet conditions.

Page 13483, Line 2: Table 1 would make even more sense if the data would be sorted from the highest (2011) to lowest (2010) water table level. This could give indication of the dominant processes that influence high water levels in the ponds – it seems that high water levels in previous year and highly saturated soil at the beginning of winter are the dominant factors that cause the increase in the pond depth. Furthermore, in Table 1 if you include year 2006 as High Winter Snowpack, then based on Fig. 2 year 2010 should be included as well.

Page 13483, Line 19: I am assuming that the pond classification based on salinity presented in Fig. 3 was determined based on the measurements of EC from 2009 – please clarify.

Page 13483, Line 22: All brackish-saline ponds become diluted, except pond 70 during 2010. Please comment on that.

Page 13483, Line 23: I am not sure what you mean by sentence: “The water flushed into ponds…. “. Please clarify.

Page 13484, Line 2: The conclusion about increase in the salt mass would be clearer if the subplot showing Msalt for the selected pond vs. time would be added in Fig.3 (if Msalt can be calculated using Eq. 1 and 2 with data from section 3.1).

Page 13484, Line 14: As mentioned before, I would present water depths in pond 109 from 1993, to correspond to all the other data analysis.

Page 13485, Line 25: As mentioned before, please explain why you think snowmelt has a negligible effect on the salt cycle.

Page 13487, Line 15: I am assuming that the valid assumption could be that there is more than one inflow/outflow point to the pond, and hence though the piezometers analysed show the inflow at that locating, the overall system could be receiving water causing decrease in salinity.

Page 13490, Line 3: In the Nachshon et al. (2013) the potential impacts of increased snowfall and precipitation are analysed, concluding that more rainfall could cause the raise of groundwater levels beneath uplands compared to ponds, which could direct the groundwater flow from upland to pond and hence increase the pond salinity. On contrary, the

increase in snowfall will increase spring snowmelt, hence increasing surface runoff and diluting the pond water. These conclusions entirely correspond to ones presented in this manuscript, and support the conceptual representation of the process given in Nachshon et al. (2013). Hence, I would suggest the authors to use the 2013 paper to support the conclusions in this manuscript, and also add additional value to their previous work.

Technical corrections:

All lines: The text is generally too dense in a sense that separating it into more paragraphs would make it much easier to read.

All lines: Since you use capital letters in Figure labelling, please use the same notation in the text as well (e.g. Fig. 1A instead of Fig. 1a).

Page 13477, Line 14: Please add the full stop at the end of the sentence "…Montana and the Dakotas in USA."

Page 13477, Line 21: I would use full stop rather than semicolon (the same applies for Line 25). If, however, the semicolon is used, then please use the small letter in Line 21 for snowmelt.

Page 13478, Line 24: You use willow ring term twice, once with and once without (Line 26) quotation marks. Please correct.

Page 13481, Line 14: Please replace "For this period,…" with "During this period,…"

Page 13485, Line 4: When explaining Fig. 5, please put subplot notation before the text, i.e. "Fig. 5 presents (A) estimated pond…."

Page 13486, Line 20: Please add comma in the sentence: "…, and epsomite (MgSO4 7H2O), which…."

Page 13499: In Fig. 5 please indicate what you mean by NC and WC (NC=normal conditions, WC=wet conditions?). Furthermore, the scale for the y-axis in subplot (B) for EC and Msalt could be decreased at least to 3000, which would make the trends in salinity change more visible.

Page 13503: In Fig. 9 please indicate dates of data sampling.