

Reply to Reviewer #3 (Dr. Goldhaber)

Impacts of climate variability on wetland salinization in the North American Prairies

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We highly appreciate the review of Dr. Goldhaber which was positive and encouraging in respect to the paper goals, concept, and its contribution to the understanding of the North American wetlands salinization processes. On the other hand the reviewer had some major concerns regarding several issues raised in the paper and we will reply to these comments in here.

In concurrence with the two other reviewers, also Dr. Goldhaber found the paper to be not clear in respect to the conceptual model of salt transport processes for extremely wet conditions associated with rainy summers and snowy winters. Consequently, we will add another section before the conclusions section to summarize and explain conceptually the processes that were observed in this study. We will describe the differences between snow-associated wet conditions where most of the water flow to the ponds over frozen soils with minimal wash of salt into the ponds, vs. rain-associated wet conditions, where infiltration and lateral flows from the uplands to the ponds results in prominent wash of salt into the ponds. The impact of salinity on the ponds ecological conditions is not in the scope of our paper, however, it was discussed by various other studies (e.g., Stewart and Kantrud, 1972; Brunet and Westbrook, 2012 and others).

The reviewer had a criticism on the fact that the transect study was done between ponds 107 and 108A, while the rest of the work focused on pond 109. He suggested that the transect study had to be done between ponds 108A and 109. This suggestion appears to be reasonable, but in fact the 108A-109 transect is very flat and short and most of the time water was flowing from 108A to 109 over the ground surface to the extent that the two ponds were almost connected. Thus observations of the subsurface conditions along the 108A-109 transect would have shown little of the processes by which salts are moved into the surface water. However, the salt content of the surface water flowing along this transect was measured from time to time and corresponded to the salinity of the water in the centre of 108A, in the range of 2000 to 3000 uS/cm as indicated in figure 8. We will add arrows in figure 8 to indicate the direction and location of overland flow during the observation period.

The most intriguing point raised by the reviewer is about the Mg/Ca ratio and the source of the dissolved salts water that are being flushed into the ponds. In the paper we showed that in 2012, after a series of wet summers the cation composition of the pond water was enriched by Mg and Na, while the molar fraction of Ca in the water was reduced. We interpreted this to indicate water flowing processes from distant parts of the uplands that are known to be rich in Mg sulfate salts. The reviewer suggested that the input of enriched Mg water into the pond is due to the Mg enrichment of the pore water (not crystallized salt) at the saline ring. It is well known from literature that due to crystallization of Calcite and Gypsum in the saline ring, close to the pond, the pore water is enriched with Mg, Na and depleted in Ca and SO_4 , (St. Arnaud, 1979). Consequently the reviewer suggests that flushing of the Mg enriched pore water is the reason to the increase of the Mg/Ca ratio. We believe that this option is interesting and likely valid. However, it is important to mention that in most spring times following the snow melt and soil thawing, some dissolved salts are washed from the saline ring to the pond and still the enrichment of the pond water with Mg was never observed prior to 2012. In the revised manuscript we will change section 3.5. that talks about the pond water chemistry to say that the Mg enrichment could be attributed also to the washing of the saline ring water as suggested by the reviewer, as well as dissolution and washing of Mg-Sulfate salts from more distant parts of the uplands. We will mention that future studies are needed to better address this point.

Last – the reviewer claimed that the salt distribution in the landscape is second in its importance compare to reaction processes of the Pyrite, Calcite, and Dolomite that can be found in the till. This is true over very long time scales (hundreds and thousands of years) and for regional changes in the water table depths. In shorter time scales that are of interest to the ecological and agricultural purposes, the salt transport, dissolution, and accumulation processes are the main story and in our paper we tried to improve our understanding of these processes. We will add one or two sentences to distinguish between the salt distribution processes described in this paper and the salt formation processes that have been described in the literature.