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Discussions

Interactive comment on "Impacts of climate variability on wetland salinization in the North American Prairies" *by* U. Nachshon et al.

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This paper presents some exciting data sets that seem to have captured a very important set of hydrologic and geochemical processes associated with Prairie Wetlands. The contrasting inputs of salts from more typical snow melt water sources and major rain events is, if a general phenomenon, is quite significant and a real advance in the science of wetland hydrologic evolution. An impact not mentioned in the paper, but one that should be looked at, is the consequences of such a rapid and large shift in salinity on wetland ecology.

The work does suffer from some weaknesses. One is that there is a focus of a part of the story on wetland 109 and another on the transect from 107 to 108. A better

transect would have been from 108 to 109 so that all the data could be linked.

I was somewhat confused as to the source of the salinity that accumulates during rain events. There is discussion of, and data presented for, the accumulation of salt in the salt ring, but also mention of upland (apparently solid phase) 'salts'. It seems to me that a simple explanation of the data is that that runoff from winter snow is over the still frozen surface and there is no access to salinity. During the major rainstorms, runoff penetrates unfrozen ground into the salt ring (whose permeability is enhanced by deep rooting of willows etc.) and transports saline water to the wetland. Research on the salt ring in the US generally shows that gypsum and calcite are the phases that form and that seems to be what Hayashi and coauthors report at St. Denis as well. It is likely that saline water is the salt source not 'salts'. Wouldn't there be a delay between the onset of the rain event and salinity appearance in the wetlands if a mass of solid phase salt was being dissolved. Figure 9 shows that the salt ring is the locus of highly saline fluids in the system. The depth interval of the salt ring sampled by the shallow piezometers may not reflect even higher salinity fluids at depth. In fact, the highest EC values are reached during the initial rain event (fig 9 line 3) when upward transport of saline ring fluids into a shallower zone seems permitted by the water table data.

I simply don't agree that salts like mirabilite, bloedite and epsomite are the source of salt or of the inverted Ca/Mg ratios during rain events. Heagle and others (J. Hydrology, 25, p 1-14) specifically exclude these phases as having formed at St. Denis based on XRD and mineral saturation calculations. A better explanation of the change in chemical composition from Ca dominant to Mg/Na dominant is the much better documented precipitation of gypsum and carbonate minerals that remove Ca from pore waters leaving them relatively enriched in Mg and Na. This is what happens in the salt ring and the waters are concentrated by transpiration and is also consistent with pore fluids and not solid phase salts as the source of excess salinity.

Finally, I think that the link to the original focus on salinization as presented in the introduction should be clarified. The process recognized in this study does temporarily redistribute salts, but the big story throughout the pothole region is the dissolution of reactive phases in the till (pyrite, calcite, dolomite) and the concentration of these reaction products in wetlands and pore fluids.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 13475, 2013.