

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

U. Nachshon, A. Ireson, G. van der Kamp, S. R. Davies, H. S. Wheeler

Reply to reviewer #1.

We are grateful to Anonymous Referee #1 for his positive and constructive review. The reviewer's summary of lateral flow/transport processes in frozen and unfrozen conditions is correct. We think the reviewer's idea of adding a conceptual diagram to show the different water flow paths for extreme snowy and rainy conditions is a good idea and the revised paper will include a short section that discusses the different water flow paths together with a conceptual diagram (attached below). In the added section we clearly explain our hypothesis about how snowmelt over frozen soils has only a small impact on salt flushing from the soils into the ponds. In addition, based upon the field measurements reported in the manuscript we will suggest that changes in salinity on seasonal and inter-annual timescales take place due to pathways from the uplands to the ponds, through the shallow subsurface (0-10 m) and not through the deeper aquifers (>15 m) (though these may influence salinity changes on longer time scales, i.e. decades to millennia). We expect this lateral subsurface flow to be dominated by saturated flow, when the shallow water table is within the "effective transmission zone" (i.e. the permeable, weathered near surface), which may persist for very short periods (on the order of days) following intense rain events (as we observed). We will emphasize that future studies need to examine this point more carefully.

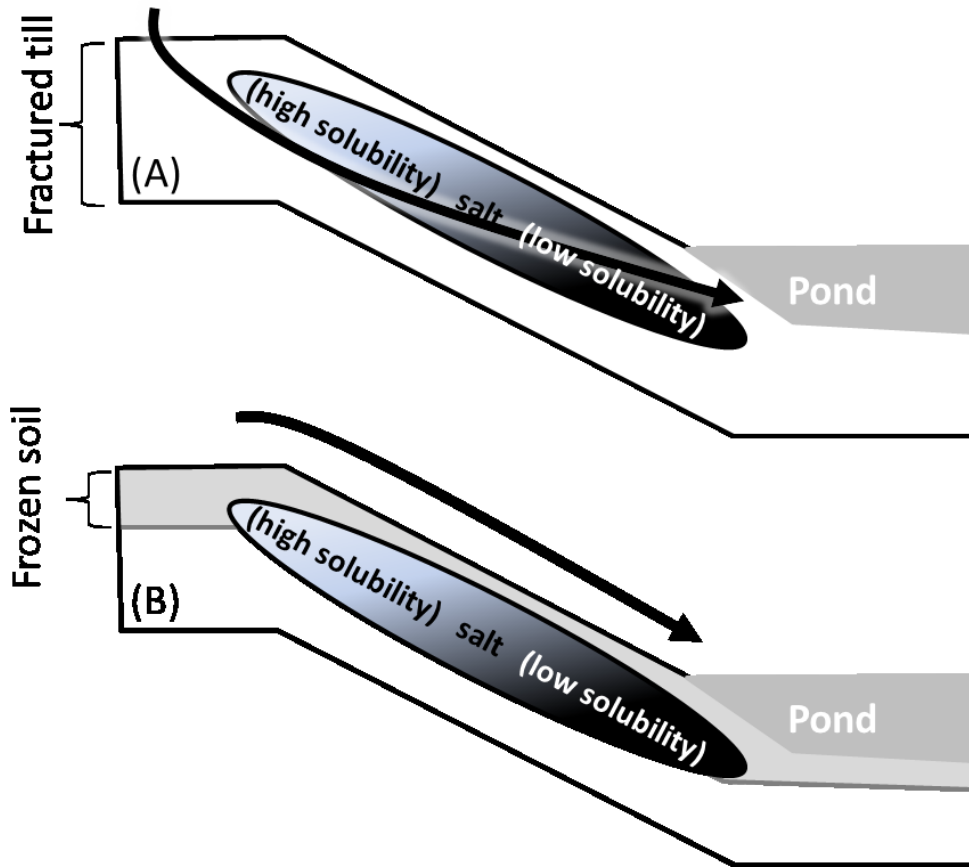


Figure 1: Conceptual diagram of water flow paths (arrows) for extremely rainy summers (A) and snowy winters (B). Oval shapes represent the accumulated salts at the uplands soil.

Below we provide a response to each of the reviewer's specific comments, all of which will be addressed in a revision. Each response references the page/line numbers associated with the reviewer's comments.

- Page 5, Line 116; reviewer is correct, 'water table depths' will be changed to 'hydraulic head'.
- Page 9, Line 236; 'The year' will be added upon comment.
- Page 10, Line 271; 'whilst' will remain in the text.
- Page 12, Line 319; text will be rephrased based upon the reviewer suggestion to make the sentence more easy to read.
- Page 12, Lines 319-321; the sentence was rephrased to be read more easily as we emphasized that the units we are refereeing to are volume units. The rephrased sentence is: "For example, for pond 109, to remove the mass of salt added to the pond by a unit volume of inflow (i.e.

exfiltration of groundwater), 3 – 5 unit volumes of outflow (i.e. infiltration of pond water) would be required.”

- Page 13, Line 345; reviewer is correct. In the M&M section we even named these pipes mini observation wells. The word ‘piezometers’ will be replaced by ‘mini observation wells’.
- Page 13, Line 353; ‘reduced’ will be replaced by ‘declined’ as suggested by the reviewer.
- Page 24, Line 521 (figure caption 5); reviewer is correct and the meanings of WC and NC will be added to the caption.
- Page 28, Lines 536-538 (Figure caption 9); text improved upon reviewer suggestions.