Hydrol. Earth Syst. Sci. Discuss., 10, C17–C22, 2013
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Hydrology and Earth System Sciences Discussions

Interactive comment on "Impact of long-term drainage on summer groundwater flow patterns in the Mer Bleue peatland, Ontario, Canada" *by* B. J. Kopp et al.

Anonymous Referee #1

Received and published: 24 January 2013

The manuscript presents a study of effects of drainage on water table elevations and peat properties. Field data were collected from the Mer Bleue peatland in Ontario, Canada. Conditions 90 years after a drainage ditch was created are compared to an undrained area of the peatland. The authors consider drained conditions to be an analog for future climate scenarios in which peatland hydrology and carbon cycling may differ. The major conclusion is that the vegetation growth after drainage changed the hydrology of the peatland resulting in a drier condition.

I am critical of several aspects of the paper and feel that major revisions are necessary before it may be further considered for publication. The analogy to future climate is

novel concept that needs to be better supported, developed, and explained. Overall, there is insufficient evidence presented to show that spatial differences in hydrology actually resulted from drainage. Without pre-drainage data to document prior conditions, the central theme of the study lacks credibility. Although the authors state that vegetation, surface elevation, hydraulic conductivities, and flow pathways have changed over time, there is no evidence to support those assertions. Citations of authoritative literature, credible anecdotes, or measurements are needed as documentation. Likewise, projections of future climate are limited to an opening statement about a drier climate with no detailed description of climate projections or documentation.

Here are some suggestions to the authors: 1. Provide a full description of the pre-drainage vegetation and post-drainage growth of the forest. Tree cores from a representative number of trees may provide some evidence of forest growth. Time series analysis of aerial or other photographs may also help. 2. Provide evidence of uniform surface elevation and peat properties before drainage. Peat core dating may provide data needed to document whether or not drainage had effects beyond natural spatial heterogeneity. 3. Given that it may not be realistic to document changes in peat hydrology, there needs to be some discussion of the possibility that peat physical properties were different before drainage and that no real change occurred due to drainage. That is, discuss plausible alternate interpretations of the measured data. 4. Cite literature that would provide projections of local or regional climate change. 5. To provide more context, discuss the contemporary rate of change of air temperature and other relevant climatic variables, at the site or within the region. 6. Expand the discussion to more completely address the future climate analogue and what it all means.

In addition to the central premise, other aspects of the paper need to be revised. Much of the peatland terminology used in the paper is confusing. Given data that document groundwater discharge, the site does not seem to be an ombrotrophic bog. Peatland hydrological terminology needs to be properly and consistently used. Finally, to improve grammar throughout the paper, many uses of "in" should be replaced with "at".

The current title does not mention climate change or future climates. A re-titled paper may better communicate the content.

p. 34, line 3-4: The analogy needs to be properly posed. The analogue to future conditions is the drained condition not the “drainage ditch.”

p. 34, line 8: Here is the first instance in which the hydrological conditions don’t appear to fit the definition of a bog. If groundwater is upwelling, these peatland areas would appear to be fens, not bogs.

p. 34, line 13: Specify the meaning of “partly.”

p.35, lines 20, 21, and elsewhere: Italics are needed when the genus and species are written. For example, Picea, Larix, and Sphagnum.

p. 36, line 2: Are lower rates of groundwater renewal projected for future climates in southeastern Ontario? Elsewhere, the authors invoke lower water tables due to changes in peat physical properties and evapotranspiration as the drivers of change after drainage, not changes to renewal, which presumably means reduced rain and snow fall.

p. 37, line 3: “Supported” is vague and possibly an inappropriate word choice.

p. 37, lines 1-2: Is it known that vegetation cover was different before drainage? How is it known that the drainage ditch affected vegetation. When was the peatland ditched and what is the age of dominant trees in the forest? Are trees ages mostly the same?

p. 37, line 21: Replace “leave” with “leaf.”

p. 38, line 21: Consider deleting “from QE” which is redundant with the immediately following text.

p. 38, line 22: Provide information on the quantification of the latent heat of vaporization.

p. 38, line 27: “Additionally” seems like a more appropriate word choice than “further.”

p. 39, line 1 and elsewhere: Quotes around bog are not needed. See previous comments regarding peatland nomenclature.

p. 39, line 2: What criteria characterize a reference site?

p. 41, lines 11-18: More direct wording may better convey what was done.

p. 42, line 21: Should “equaled” be replaced with “were equal?”

p. 44, line 21: “pattern” is unnecessarily repeated.

p. 44, lines 24-26: Runon and unclear sentence.

p. 45, lines 7-9: The clauses of the sentence don’t seem to be related.

p. 46, lines 1-6: Runon sentence.

p. 46, line 20: Remove the extra space.

p. 48, line 21: Fix the spacing and dashes.

p. 49, line 18: Why would new additions of plant material have any effect at depth? The new plant material could not have been deeply buried.

p. 49, line 19: Instead of “of model behaviour,” include the specific response variable.

p. 50, line 6-7: The use of “vice versa” is not specific enough.

p. 50, line 12: A grammar correction is needed, “ET was modeled.”

p. 50, line 20: Specify how the flow pattern was consistent. Over time?

p. 51, line 20: The growth of vascular plants needs to be documented somewhere in the document.

p. 51, line 21: The word “this” is a modifier. The dangling modifier needs to be addressed.

p. 51, lines 26-27: The authors have not provided any evidence that hydraulic conductivities have increased due to drainage. They have only shown that hydraulic conductivities are spatially variable across the peatland.

p. 52, line 2-5: The phrase “we cannot support this idea by measurements of nutrient fluxes” needs to be fully explained.

p. 52, lines 19-21: This sentence is an example of hydrological explanations that do not make sense in relation to the terminology. How can the treed area have inputs of groundwater and be a bog? This information also seems to contradict an earlier statement that implied that areas surrounding Mer Bleue were well drained and drained away from the bog (p. 38, lines 8-10). That information would indicate that there should be little or no connection of the catchment to the peatland which is a stark contrast to this sentence. These discrepancies need to be addressed by using terminology that is consistent with the ancillary information that is presented elsewhere in the document.

References: Fix the Baird et al. citation.

Tables 1 and 2 may be of secondary relevance and better placed in the supplemental materials.

Figure 1. The map and lines superimposed on the cross-section makes a somewhat cluttered image. I suggest separating these distinct informational images.

Figure 3. The lines of information above each figure panel are not well explained or readily understandable.

Figure 5. None of the flowlines suggest bog hydrology. This figure is another example of terminology that is not consistent with the results. Additionally, the flowlines suggest inputs of water from outside the peatland, which again is not consistent with descriptions of watershed connectivity.

Supplemental information: What are hydrologic triangles? The text from lines 2-20 seems highly repetitious with information that is presented elsewhere. If there is some

unique info written here, consider merging it into the body of the paper and deleting the mostly repetitious supplement.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 33, 2013.