

Review of the manuscript hess-2017-282
“Hydrogeological controls on spatial patterns
of groundwater discharge in peatlands”
by D K Hare, D F Boutt, W P Clement,
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1 General comments

The paper discusses the mechanisms through which seepage occur in peatlands, by means of the analysis of a test case (a kettle-pond peatland in southeast Massachusetts) conducted by integration of isotopic, GPR, thermal (Fiber-optic distributed temperature sensing; Infrared ground surveys; Temperature loggers for 1D vertical temperature profiles) and traditional hydrogeological data.

The paper is quite interesting, especially for the non-standard mix of different methods.

In general it is written quite carefully (see in the “technical comments” below a list of possible corrections), but some (moderate to major) modifications are necessary to improve its scientific content.

2 Specific comments

1. Throughout the paper measurement units are written extensively (e.g., meters, nanosecond), whereas their symbol should be preferred following the numerical value (e.g., m, ns), according to the SI recommendations.
2. The quality (namely, depth of investigation and resolution) of GPR data is strongly dependent on both the electrical conductivity of the materials through which radiowaves propagate and the emitted frequency. In the study case, the shallow portion of the subsurface should be quite conductive and therefore quite absorbing, thus limiting the depth of investigation; on the other hand the chosen frequencies are relatively low, so that a useful depth of investigation can be reached, even if the wavelength (and therefore the resolution) could be relatively large. I think that some estimates and a discussion of the depth of investigation and of the resolution, based on the soil physical properties and the fundamental frequencies of the transmitting antennas, could be useful.
3. Figure 2 shows a relatively important dip of the reflecting horizons. Is this an artefact of the vertical exaggeration? Or would it be useful to perform a migration in order to properly map the dipping reflectors?

4. Figure 9 is of modest quality and is not very relevant.

First of all it is not clear whether it is the result of a numerical model or a conceptual drawing. In the first case, details are totally missing and it is not obvious why the uppermost contour line of hydraulic head appears to be slightly wavy at some places.

From this figure it seems that poorly permeable peat prevents from matrix seepage unless the peat thickness is sufficiently small; on the other hand, when peat thickness is relatively great, seepage may occur through preferential flow paths (PFPs) only. Can you provide quantitative statements which are conferred general validity from this single case study?

Do PFPs occur where the peat base is folded, as shown in Figure 9, only or might PFP occur elsewhere? Despite the extensive “Discussion” section, I was not able to find a clear answer to these questions.

3 Technical comments

1. Line 59. Rephrase “Upwelling... cycling”.
2. Line 80. Substitute “our” with “the”.
3. Line 88. Rephrase “is consolidated 3 cranberry farms”.
4. Line 94. Erase “groundwater”.
5. Line 95. Please, explain “surrounding”.
6. Line 96. Please, rephrase. I do not understand what “which” is referred to: PCKD aquifer or glacial outwash sands?
7. Line 99. Substitute “2 kilometer” with “two-kilometre-long”.
8. Line 102. Rephrase “Cranberry farming practices had applied”.
9. Line 103. Use lower case “s” in “site”.
10. Line 117. Rephrase “to help guide”.
11. Line 135. Rephrase “Seepage meter measurements”.
12. Line 145. Erase “of” before “the 100 MHz data”.
13. Line 151. Please, give more details on the “automatic gain control”.
14. Line 158-159. Substitute “peat-sand interface” with “peat thickness”.
15. Line 177. Add “-long” to “Fifty-meter”.
16. Line 188. Substitute “-” with “to”.
17. Lines 191-192. Rephrase “on the 5-day time series at every 1-m along the cable”.
18. Line 193. Please, explain “which is not possible for other “snapshot” in time methods”.
19. Line 225. Rephrase “such that their located”.
20. Lines 243 to 245. Rephrase “Upper 1-meter... for analysis.”
21. Lines 254 to 256. Please, explain “Results are calculated... of the sample.”
22. Lines 272, 275. Add “s” at the end of “Cell” in “Cell 6 and 7”.
23. Lines 290-291. Rephrase “that is... $\pm 3 - 5$ °C;”.
24. Line 302. Rephrase “most groundwater-influenced temperature”.
25. Line 311. Substitute “on the interior of”, possibly with “in”.
26. Line 320. Substitute “their” with “a”.
27. Line 373. Rephrase “a repeatedly sampled of strong discharge”.
28. Line 395 to 397. Please, rephrase “Therefore,... by Conant Jr. (2004).” and add details.
29. Line 474. Is “lakes” correct? “Lake bottoms”, maybe?
30. Line 615. Correct the reference details.
31. Figure 2A. Use lower case “k” for “kilometers”.
32. Line 884. Add “n” to “show”. Rephrase “3D surface”: a surface is a 2D object.
33. Figure 9. Linear dimensions are missing.