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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Using hydrologic measurements to investigate free phase gas ebullition in a Maine Peatland, USA" *by* C. E. Bon et al.

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Please see attached .zip file for supplemental material (text, figures, and figure captions).

Referee #1 1. Water level readings were changed to SI units: Page 9731, line 23 were converted from ft to m Figures 7, 8, 9 were also converted from ft to m.

2. Page 9724 line 26 of the introduction was broken up into 3 statements that more clearly stated the mechanisms of ebullition: "Ebullition events have been known to occur in response to a rising water table as the buoyancy of formed bubbles causes them

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to propagate upwards with the rising water table (Coulthard et al., 2009). Decreases in atmospheric pressure were thought to cause an increase in pressure difference between pore fluids and the atmosphere causing free phase gas bubbles to release to the atmosphere (Tokida et al., 2007). Ebullition events have also been known to occur as 4-12 hour events as peat depressuring cycles (Glaser et al., 2004)."

3. The pe and Eh were not measured at the study site. Without this data, it is difficult to determine the redox potential. The focus of the study was on CH4 content and the hydraulics of the systems, and therefore basic geochemical analysis was not funded for this study. We do believe, as was stated, that the favored pathway in shallow peat would be through the breakdown of acetate but we are not ruling out some reduction of CO2.

4. Figure 2 was updated: Labeled Pushaw Lake and outlined the approximate edges of the peatland. I have also changed the figure to include only a map of the study area. Some information, such as the esker and the well sites, overlapped with Figure 10 and are now included in Figure 10. The GPR image of the esker has been deleted because it was difficult to read and can be found by looking up the corresponding reference.

5. Figure 2 was updated to delineate Pushaw Lake and the edges of the peatland. The central unit is also highlighted in the left image and shown enlarged in the tight image. This better shows the fan or kidney shape of the peatland and drainage into Pushaw Lake.

6. The document was fixed to show that the PVC wells were inserted with a slide hammer and hit until the desired peat depth was reached.

7. The function of the wooden frame is now described more clearly: "Two wood boards (3.81 cm x 6.35 cm x 121.92 cm) were clamped together and eight 2.54 cm diameter holes were drilled through the boards with the hole centered along the surface of the intersecting boards. The boards were then clamped around up to eight wells using 9 bolts to tightly clamp the wooden boards around the wells. The deepest wells were

positioned at the ends of each well cluster and typically extended into the mineral soil. The frame would prevent individual movement of a well during peat deformation."

8. The uncertainty was indeed +/- 5 cm. This could affect GPS data and could be a reason for the bulge in the hydraulic head data around the question marks in Figure 10. This was changed in the Discussion of the hydraulic data (5.2). Although there is an uncertainty in the height data, there is undoubtedly a convergence of flow near the esker crest that is different from the regional east-west flow towards Pushaw Lake.

9. The accuracy of the manual measurement off the tape measure is +/- 1 cm. This was changed in document.

10. The pressure transducers are non-vented and were corrected for barometric pressure with readings from the barometric data logging pressure transducer at well site [ii]. The barometric pressure was subtracted from well data readings to give a water level reading. This is now included in the document.

11. In section 3.1, we have added: "To reduce the importance of well storage and its impact on monitoring well response, 2.1 cm diameter PC pipe were inserted in each monitoring well from the surface to about 1 m below the water level. This reduced the cross sectional area in wells by 33% while still allowing direct measurement of water levels."

12. The University of Maine is located 6.5 km to the east. This has been changed in the document.

13. Changes have been made that should clear up the uncertainties: "To reduce headspace, the gas traps were fashioned with water filled, 2.54 cm diameter, polyester film tubing that was heat sealed on one end and attached to a cork that sealed the well on the other (Fig. 3). The tubing was positioned so that there was 10 cm of headspace above the current water level to allow for water level fluctuation. The tubing was then filled with water so that the tubing filled to the diameter of the well and sealed with a

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cork."

14. The water filled baggy refers to the water filled tubing and was been corrected (see 13).

15. This was polyester film tubing (generic name) made from resin (PET) polyethylene terephthalate and has been corrected (see 13).

16. The sentence has been changed to: "A 6.35 mm clear vinyl tube, that ran from the headspace, alongside the polyester film tubing, and through the cork sealing the well, allowed headspace gasses to flow out of the well and into the attached to a 50ml Nalgene bottles. These bottles allowed water to flow out as the headspace gasses move in."

17. We have added that this is a vacuum hand pump in the methods section. In the discussion of Gas and Water Samples (5.1), I have added that "Although none of our tested water samples showed concentrations that were supersaturated with respect to CH4 or CO2, bubbles were seen forming in the capped 10 ml glass vials soon after collection. Some degassing of samples may have been possible upon collection when samples were transferred from the Erlenmeyer flask to the 10 ml glass vials, although samples were carefully transferred. The shallow peat model would suggest. . ."

18. The initial level indicates the May 22nd level. This has been cleared up in this sentence: "Samples collected on May 24, 2012 were at roughly half the CH4 concentrations seen on May 22, 2012 for all wells."

19. Figure 4 now has different symbols for day 1 and day 2. The bottom plot for CH4 vs. CO2 now has two trend lines; one for each sampling day. The same change was also made for Figure 5 (CH4 Concentrations- Pool and Esker Site).

20. A pattern is not seen in the change in CH4 conc. from day 1 to day 2. More than half are higher, but some are lower or very similar. No changes were made.

21. This sentence refers to concentrations of CO2 and has been clarified: "Highest

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concentrations of CO2 were found at 6 m."

22. The saturation concentration of CO2 at standard pressure and 20 ÌŁC is 1.45 g/L. This has been added to the document: ". No samples were supersaturated (1.45 g/L at standard pressure and 20 ÌŁC; (Wiesenburg and Guinasso, 1979)) with respect to CO2."

23. We have added "Daily fluctuations in hydraulic head data match the patterns attributed to evapotranspiration in wetland systems (Mitsch and Gosselink, 2007) due the nighttime recovery of water levels and because fluctuations only occurred during the growing season. Data also showed unusual fluctuations lasting. . ."

24. The sentence has been revised: "Fluctuations are spikes of 2 to 5 cm in hydraulic head data that occur during decreasing atmospheric pressure are accompanied by a rising water level due to precipitation (Fig. 7)." No further changes were made because the following paragraphs go into further detail on the subject.

25. We have added a reference to Figure 6 and "Unusual fluctuations in hydraulic head were interpreted as FPG movement and release within the peat column (Fig 6). Hydraulic head typically increases rapidly with increased hydraulic heads lasting a few hours, followed by a sharp decrease in hydraulic head, and finally a recovery of hydraulic head back to levels consistent with long term data. This pattern may occur several times over longer duration events and these events end when lowest atmospheric pressure is reached and precipitation ends. These events are recorded more frequently by wells screened more than 3 m below the peat surface."

26. A cross section showing well screens was not included.

27. The actual width of slots is 0.5 mm. This has been added to the paper.

28. The gas traps were set up to catch these kinds of events but gas concentrations from the gas traps did not indicate measureable gas change in the headspace. This leads us to believe that the wells are not a mechanism by which significant gas is

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released either by diffusion or ebullition.

29. We believe that concentrations were measured and calculated correctly. The field methods of Romanowicz et al.(1995) and calculations of Kampbell and Vandegrift (1998) were followed precisely.

30. We believe that the orange well (now the 5.2 m well) is the first well to fluctuate slightly at 03:00:00. No changes were made.

31. Figure 2 has been updated and is now a map of the study area. Overlapping information with Figure 10 has been included in Figure 10. The GPR image of the esker has been deleted because it can be found by looking up the cited paper.

32. After the corrections from comment # 19 and some revisions, we believe that Figure 4 and 5 are now journal quality.

33. The caption for Figure 6 now includes the statement that, "Each x-axis label represents the zero hour of the day."

34. A topographic map was tried for Figure 10 but was not used because the relief was less than a meter on USGS maps and the figure became difficult to read.

35. Figure 11 has been corrected to have consistent data with Figure 10. The water level measurements for Figure 11 had been subtracted from the top of the GPS antenna instead of from the top of the board holding the wells in place.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/10/C7119/2014/hessd-10-C7119-2014-supplement.zip

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 9721, 2013.