Hydrol. Earth Syst. Sci. Discuss., 10, C2639–C2646, 2013
www.hydrol-earth-syst-sci-discuss.net/10/C2639/2013/

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Regional and local patterns in depth to water table, hydrochemistry, and peat properties of bogs and their laggs in coastal British Columbia" *by* S. A. Howie and H. J. van Meerveld

S. A. Howie and H. J. van Meerveld

sarah_howie@sfu.ca

Received and published: 18 June 2013

Response to Review #2

We thank the reviewer for his/her thorough review of this manuscript. We address each of the reviewer's comments below.

General Comments:

Contribution to International Peatland Science: The objective of the study, as noted by

the reviewer, was to improve our understanding of the environmental gradients across bog margins and to determine whether these gradients are consistent for bogs throughout coastal BC. The results show that these gradients are highly variable, even within the wetland regions of the study area. As noted in our response to Reviewer #1, we agree that most results of this study are specific to coastal BC and not directly applicable to other regions. However, we do think that it is of interest to other researchers (and resource managers) to know that there are large variations in lagg characteristics locally and regionally, and we therefore do not agree that the results presented here are only of local interest.

We believe that the results of this study are of interest to other researchers because: 1)there are few studies on the lagg and this study provides information about environmental gradients across this transition zone, as well as showing that these gradients are highly variable locally and regionally; 2)we show that ash content may be a useful variable for delineation of the lagg, and that ash content may have a stronger influence on hydrochemical conditions in the lagg than topography or peat depth; and 3)these results add to the international body of literature to move towards a holistic understanding of lagg structure and function.

We will explain more clearly in the text how our results are useful outside of the study region.

Terminology: We thank the reviewer for noting that our terminology is largely derived from the Canadian system of wetland classification. We will review the manuscript with this in mind and provide the international terms in addition to the Canadian terms. We will also ensure that our working definition of 'lagg' ("the hydrological, hydrochemical, and/or vegetative transition zone at the margin of a bog, regardless of whether a vegetative ecotone is present") is explained with respect to the locations of the study transects. Not all 'lagg' sites were 'confined', as suggested by the standard definition of 'lagg'; some of the transects were purposefully located in 'unconfined' conditions at the mire margin in order to capture the variability of bog margin forms.

HESSD

10, C2639–C2646, 2013

Lagg Morphology: We will ensure that lagg morphology is mentioned throughout the paper as a "factor that should be considered in the context of peatland restoration", as suggested by the reviewer. We can also more clearly explain how the transect locations were chosen in terms of lagg morphology/function and in relation to the surrounding landscape. As noted in Howie and Tromp-van Meerveld (2011), bog margin transitions are highly variable, even around a single bog. We aimed to capture this variability in our inventory of laggs. We therefore chose a variety of lagg forms to study, including the topographic forms described as 'confined' and 'unconfined' by the reviewer, and a variety of vegetative ecotone types. At any given bog, a representative lagg ecotone (or the most representative bog margin condition in the absence of a well-defined lagg ecotone) was chosen for study. In general, the 'confined' laggs supported a vegetative ecotone (e.g. shrub swamp or graminoid fen), while the 'unconfined' laggs were less well-defined (e.g. a vegetative transition from open bog to forest).

Selection of Transect Stations: The reviewer correctly notes that not all LG (lagg) stations were located in 'confined' depressions at the bog margin. A number of the LG stations were higher than the BG (bog expanse) stations; this gradual transition from raised bog to blanket bog is common in the colder, wetter areas of the coastal BC region, and we wanted to capture this transition in our study as well. Also, in two instances (Tow Hill Bog and Blaney Bog FN) the MN (mineral ground) stations were lower than the LG stations, meaning that the LG stations did not receive surface runoff from the mineral soil. A key goal of this study was to describe the variability of bog margin conditions because not all bogs are surrounded by a topographic depression and a moat-like lagg. We can make this clearer in the text, and explain the reasons for the transect stations in locations that do not fit the classic definition of lagg (e.g. the Blaney Bog FN site) more clearly.

The reviewer suspects from Fig. 2B that Burns Bog is artificially confined at the margin. This is not the case. According to historic air photos, Crescent Slough (labelled in the figure) is the natural boundary of the bog in this area. The mineral soil in the farm

HESSD

10, C2639–C2646, 2013

adjacent to Crescent Slough does not affect the transition from bog to lagg in this area because it lies beyond the historic lagg stream of the bog. However, the ideal MN (mineral) station would have been on the farmed side of Crescent Slough, in whatever vegetation form existed prior to farming. We can make this clearer in the text.

The reviewer questions whether the LG stations in Burns Bog are representative of natural lagg conditions due to the presence of roads through the transects. It is possible that the roads did cause minor changes to the hydrology. However, one of the roads (Highway 91) was built with lightweight fill to 'float' on the peat and contains numerous culverts designed to maintain the hydrologic connection across the highway. The other road is constructed of porous wood chips; this material is unlikely to affect the hydrology in a substantial way. We can make this clearer in the text and identify the locations that could potentially have been affected by disturbances, albeit in a minor way. As noted elsewhere, the transect stations were located in areas that on the basis of our review of historic aerial photographs appear to be relatively unaffected by disturbances such as roads, peat mining and drainage.

As noted by the reviewer, some of the MN sites were located in wet, partly organic soil at the bog margin, instead of rocky, dry mineral soil from which a water sample could not be obtained. The reviewer questions whether these sites are actually the functional lagg, as opposed to being representative of the mineral soil adjacent to the bog. In these cases, we believe that the MN sites were on the outer margin of the functional lagg, as close as possible to the true mineral soil adjacent to the bog. The vegetation in these MN stations indicated a higher concentration of nutrients (as described in local indicator plant reference books) and were more representative of mineral soil conditions compared to the LG stations on the transects. We can explain this distinction more clearly in the text and discuss the effect of the position of these sites on the results in more detail as well.

The reviewer notes that the water level in the lagg was higher than in the bog expanse in 6 out of 16 transects, and questions whether these study sites are actually bogs since

HESSD

10, C2639–C2646, 2013

water could flow towards the bog from the lagg. As noted on P3149 L9-12, P3155 L3-6, and P3156 L13-14, 'slope bogs' are common in the study region. These bogs are similar to blanket bogs, forming on slopes in areas with high mean annual precipitation. Similar to blanket bogs in other regions, these slope bogs can be ombrotrophic despite having formed on sloping ground. However, it is also possible that some sites are transitional between bog and poor fen rather than purely ombrotrophic bogs (the subtle gradation between bog and poor fen can be difficult to differentiate), and we should have mentioned this possibility in the text. Minor flow reversals are possible in summer as well, but the high rainfall in the slope bog regions is expected to 'flush' minerotrophic water from the peat.

Data Analysis: The reviewer suggests grouping the data for analysis on the basis of 'function' and 'naturalness' in addition to 'vegetative' criteria. Regarding 'function', we could possibly analyse the data in groups according to topographic form (e.g. 'confined' vs. 'unconfined' laggs). We did look at this for the 'clustering' of pH and Ca2+ concentrations (P3161 L16-25) but topographic position of the lagg in relation to the bog did not appear to be a main factor affecting the hydrochemistry. With respect to 'naturalness', every effort was made in this study to choose locations that appeared to be relatively unaffected by disturbance (based on vegetative patterns in historic air photos); thus, all of the study sites had a high degree of 'naturalness'.

Goal of the Study: Contrary to the reviewer's impression that this study was not originally focussed on the lagg, our intention was to improve the understanding of lagg structure and function. The goal was to survey a representative number of lagg sites in the coastal BC region, in order to create a classification of laggs in the region and determine which variables are the most useful for future, more detailed lagg studies. We therefore did not only focus on the classic 'confined' lagg with a well-defined ecotone, but purposefully studied bog margin transitions with different geomorphic/topographic characteristics.

Correlation of Bog Radius and Dome Height: As noted by the reviewer, the Fraser Low-

HESSD

10, C2639–C2646, 2013

land bogs have all been subject to some type of disturbance, such as peat mining and drainage. However, the study sites were intentionally located in undisturbed areas of the bogs. Thus, we do not believe that past disturbances would have had a significant effect on the correlation between bog radius and dome height. However, we can make this clearer in the text.

Piezometers vs. Dipwells: The reviewer correctly notes that the response times in the piezometers could have been slow in some sites due to the installation in dense peat and mineral soils. For this reason, we allowed several days for the piezometers to recharge; we used data from a 1.5-year temporal study of the water table and water chemistry at Burns Bog and Blaney Bog to determine the appropriate recharge time.

The reviewer also comments that dipwells are normally used to measure depth to water table, instead of piezometers. Based on previous measurements in shallow piezometers and dipwells in Burns Bog, we expect the water level measured in the shallow piezometers to generally be within 1-2 cm of the actual position of the water table (see Fig. 1 below for a comparison between measurements in a dipwell and a piezometer); we will make this clearer in the text and provide more details on why we make this assumption. The reason that we did not use dipwells (with screening along the entire length), as suggested by the reviewer, was to avoid "short-circuiting" of water from the bog surface into the well, which would affect the hydrochemical measurements and could artificially raise the height of the water level in the well above the actual water table level during periods of heavy rainfall. The coastal BC region receives high precipitation, even during the summer months. We can make this reasoning clearer in the methods section.

Results & Discussion: It was suggested that the Results and Discussion sections be separated. We amalgamated these sections in this manuscript in order to reduce repetition and manuscript length. Reviewer 1 agreed that this was indeed an effective way of keeping the paper within a reasonable length, especially considering the large number of variables in the study. However, if the editor agrees that the manuscript should

HESSD

10, C2639–C2646, 2013

contain separate Results and Discussion sections, we can of course make this change.

Conclusion: The reviewer suggests shortening or removing the Conclusion, as part of it summarizes the results. The Conclusion was purposefully written in this way, in order that readers could quickly review the most important results of the study. However, we can shorten or remove the Conclusion if the editor agrees with the reviewer.

Specific Comments:

Parameters: Instead of using the word “parameters”, we can use the alternatives suggested by the reviewer in the specific locations mentioned (e.g. variables, factors, ion concentrations, attributes).

Spelling: We will check with the editor regarding “Americanized” spelling of words and revise the spelling in the manuscript accordingly. We will also replace the word “likely” with “probably”, as suggested by the reviewer.

Comma Usage: We can remove the commas inserted between the penultimate item of a list and the connecting ‘and’, if that is the format preferred by this journal (e.g. P3150/L7 “Shorepine Bog, Burns Bog, and Blaney Bog” should be written “Shorepine Bog, Burns Bog and Blaney Bog”).

References:

Howie, S.A. and Tromp-van Meerveld, I.: The essential role of the lagg in raised bog function and restoration: a review, Wetlands, 31, 613-622, 2011.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 3143, 2013.

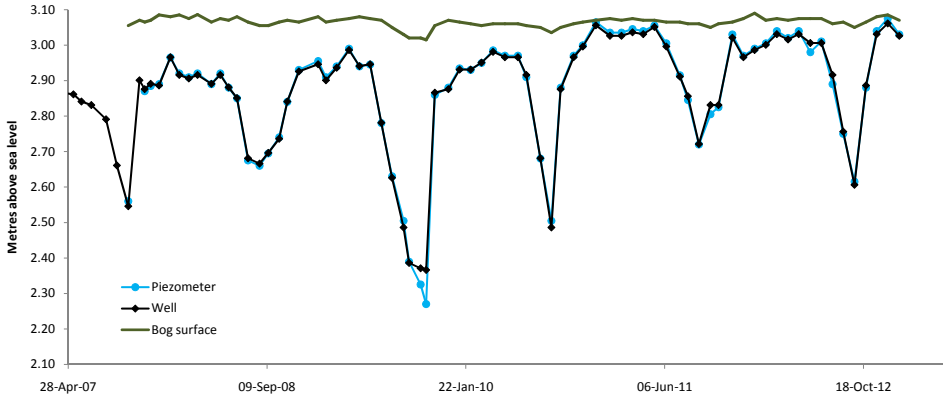

Figure 1: Comparison between the water level elevation (masl) for a well and a piezometer (with screening at 0.6-1.5 m below the surface) less than 1 m apart in Burns Bog, Delta, BC.

Fig. 1.

HESSD
10, C2639–C2646, 2013