

## ***Interactive comment on “A Synthesis of Three Decades of Eco-Hydrological Research at Scotty Creek, NWT, Canada” by William Quinton et al.***

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P2 Line 18 discusses precipitation and stream gauging networks with reference to figure 2. The expectation is of a map that shows gauging sites, but this is missing.

â€” Symbols have been added to Figure 1 indicating the locations where the data presented in Figure 2 was collected.

P3 section 2. This is a paper about hydrological functioning, but no basic data are provided to introduce the climate context for the basin. We need a brief summary of the climatic setting and precipitation characteristics, and a sentence or so on the flow regime.

â€” Precipitation has been measured at Fort Simpson, 50 km north of Scotty Creek

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since 1896. However, precipitation and streamflow data records at Scotty began only in 1996. The reviewer makes a good point, so we will use streamflow data from the adjacent Jean Marie River (1972-present) to characterise in a few sentences, the flow regimes for the study region.

P3 line 2 delete ‘through this process’. It’s not clear what this process is and the phrase is in any case unnecessary.

â€” ‘Through this process’ has been removed.

P4 line 9 delete comma

â€” deleted.

P4 Line 13 maybe ‘primary hydraulic function’ - there are many functional aspects of these systems

â€” ‘primary function’ changed to ‘primary hydraulic function’.

P5 line 2 insert comma after 2003)

â€” Comma added

P5 Lines 14, 16, 17 – too many ‘unique’s – poor English.

â€” These sentences have been revised as follows:

“Collectively, these studies helped to define the hydrological functions of the land cover types that predominate not only at Scotty Creek, but throughout much of the peatland-dominated zone of discontinuous permafrost. These studies also illustrate the unique hydrological behaviour of sub-arctic peatlands compared with their counterparts in warmer climates.”

P6 line 4 ‘total porosity decreases by 10%’ - please be specific, is this a 10% decrease in the porosity value, or is the porosity expressed as a percentage changing by 10? There is a use of undefined terminology here – what is meant by water storage coeffi-

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cient, and active porosity? How is active porosity different from drainable porosity?

â€” To address these comments, the paragraph was re-written as follows:

“Quinton et al. (2000) reported that the values of total porosity decreased only slightly with depth, from approximately 95% in the 0-5 cm zone to 85% at 35 cm depth. However, the authors reported that over this depth range, values of ‘active porosity’ (i.e. the proportion of the total peat pore volume that actively transmits water (Romanov, 1968)) typically decreases from approximately 80% to <50%. The authors measured active porosity from image analysis of 2D thin sections of peat samples, whereby the inter-particle area expressed as a percentage of the total image area was assumed to approximate the active porosity. Quinton and Hayashi (2004) also demonstrated that the fraction of the total porosity that conducts water decreases with increasing depth, although these authors did so through drainage experiments. They reported that the ‘drainable porosity’ (i.e. the pore volume of water removed when the water table is lowered) decreases from approximately 0.6 near the ground surface to 0.05 at 40 cm depth. These relatively low values, especially at depth, enable a rapid response of the water table to hydraulic inputs to the ground surface. This rapid response is enhanced by very high infiltration rates and the close proximity of the saturated zone to the ground surface. Laboratory drainage tests combined with microscopic image analyses indicate that with increasing depth, the proportion of small, closed and dead-end pores increases as does the water content for a given pressure, and that the peat maintains a residual volumetric moisture content of 15-20% (Quinton and Hayashi, 2004).”

How is a decrease of ‘only 10%’ consistent with a ‘rapidly decreasing’ storage coefficient?

â€” The different expressions of porosity (total, active, inactive) were used to demonstrate that the ratio of water that can flow and that which remains in storage changes with depth such that the storage fraction increases with depth. That is what was meant by the depth variation in the storage coefficient. However, we agree with the reviewer

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and have taken his/her advice and provided more explanation in the paragraph (above). The reason for the greater storage of water with increasing depth is due to the decreasing ability with depth of the peat to convey water, as measured from image analysis (active porosity) and drainage tests (drainable porosity).

P6 Line 18 k is loosely defined here as permeability. Presumable intrinsic permeability is what is meant.

â€” Correct. We are referring to the soil permeability [L2] which depends only on the properties of the medium, e.g. the size, shape, number, distribution and continuity of the conducting pores. Freeze and Cherry (1979) suggest the approximation,  $k = cD^2$ ; where c, is a dimensionless coefficient and D, is the pore or grain diameter.

P9 line 25 retained rather than detained

â€” The change has been made.

P10 line 5 delete comma after 2003, insert comma after ‘that’

â€” done

p10 line 30 the SFASH model p12 line 20 insert comma after plateaus,

â€” done

P16 line 7 what precisely is meant by a composite hydrograph? Is this the mean over the period, or something different?

â€” Agreed. The word “composite” was removed and replaced with the word “mean”.

P16 line 28 what precisely is meant by ‘soil moisture’ here? It’s difficult to see how total moisture would increase if porosity decreases.

â€” This sentence has been modified as follows:

“The initial disturbance displaces the ground surface downward where it is closer to the water table. As a result, the soil moisture content (and therefore the bulk thermal

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conductivity) of the peat near the ground surface increases, and preferential ground thaw is initiated.”

P17. Summary. Please summarize conclusions for basin storage. Only flows are discussed.

â€” The summary has been revised so that it includes conclusions for both flow and storage processes.

P18 the paper ends quite abruptly. We need a section of reflection here. After such extensive field work over a long period, what are the outstanding gaps in knowledge and primary requirements for future work?

â€” The conclusion is being revised so that it includes discussion of outstanding gaps in knowledge and primary requirements for future work.

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