Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-404-RC1, 2016

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Quantifying hydrologic connectivity of wetlands to surface water systems" *by* Ali A. Ameli and Irena F. Creed

Anonymous Referee #1

Received and published: 10 September 2016

This paper covers a very timely topic and would be a nice addition to HESS. The concept of hydrological connectivity is still in its infancy, but its relevance to the wetland management is obvious, even as hydrologists are still learning how to apply the concept. The authors are to be commended on their efforts to advance the thinking on this subject. The study summarized in this paper applies a series of process based models to quantify surface and subsurface hydrologic connectivity among wetlands and a major river, in order to address several goals. These include assessing the performance of the models, comparing the relative importance of surface and subsurface connections, determining if proximity can be used as a substitute for connectivity, and if their findings could be extrapolated beyond the study watershed. The authors meet all these goals but only to different degrees, and I have provided some suggestions that might elevate the study and manuscript. There are some major comments, and numerous

minor ones.

MAJOR COMMENTS

1) Could the authors perhaps present data from the surface overland flow model for a dry year? I understand why they selected 2013, but it would be good to know that the model could represent a condition that is drier, and what those repercussions are for connectivity. One downside of the research as presented is, it does not necessarily present the spectrum of connectivity that could occur in the Beaverhill watershed.

2) A more critical assessment of the simulated surface flow hydrograph is needed. The high regression coefficient is likely because of the low flow period, and the spring peak, which is relatively well simulated. The true test of a modeled surface stream hydrograph in the Prairie Pothole Region is how well it represents the summer recession, any summer events, and timing of the cessation of streamflow. The model does not do this particularly well. The manuscript would be improved if the authors explain their theories as to why the model simulated an event that did not happen, and missed one that did. Could it be that the model missed some important re-connection? If so, why? This will help inform how the model is behaving and provide some great insight.

3) I would argue that the authors misinterpret the content of Figure 9. There is good fit for short distances, but not long. Could the authors please provide more information on how the shortest distances were calculated? Are these Euclidian (ie "as the crow flies") estimates? Or are they along the topographic flow path? Did they come from the digital elevation model? If this is the case, this might explain the departure from the linear function in Figure 9. If I interpret the results correctly, this highlights the problem with the variety of connectivity metrics, measures and indices that are currently used in hydrology. To really address their goal of determining if proximity is a substitute for connectivity, it would be great if the authors could output the contribution of flow from each wetland to the North Saskatchewan River, and plot these flows against distance. This would truly show if distance is (or is not) a proxy for connectivity. The authors do

not use a metric that demonstrates the magnitude of connectivity, only its presence or absence. They need one for magnitude to answer their question if proximity can be used as a substitute for connectivity.

MINOR COMMENTS

Some relevant work the authors should consider working into the manuscript are listed below.

Shook, K., J.W. Pomeroy, C. Spence and L. Boychuk, 2013. Storage dynamics simulations in prairie wetlands hydrology models: evaluation and parameterization, Hydrological Processes 27: 1875 – 1889.

Brannen, R. C. Spence and A. Ireson, 2015. Influence of shallow groundwater-surface water interactions on the hydrological connectivity and water budget of a wetland complex, Hydrological Processes 29: 3862-3877.

Hayashi, M., G. van der Kamp and D. Rosenberry, 2016. Hydrology of prairie wetlands: understanding the integrated surface-water and groundwater processes, Wetlands doi: 10.1007/s13157-016-0797-9

Page 1 Line 22: Could read: " ..... protection, as these are small features typically vulnerable to drainage or manipulation ....." As for the rest of the sentence, please provide information on why being numerous equates to a need for protection.

Page 1 Line 25: Maybe reference Brannen et al. here too.

Page 1 Line 26: I know that fill-and-spill has become common vernacular, but perhaps the authors could say "..... via mechanisms analogous to fill-and-spill runoff generation (Rains et al., 2006)."

Page 1 Line 29: Be very careful when using the term "function" because it has very specific meanings depending on the context. For instance, the hydrological function of a specific wetland using the hydrogeomorphic assessment method, which can be

required for development works, follows methodologies necessary for the specific purpose of discerning a loss or gain in wetland function relative to a reference standard. This approach was designed to detect and measure variation in function due to human impacts, not natural variation. In contrast, Black (1997) proposed that landscape units have hydrologic functions such as collecting, storing and discharging. Could I suggest the authors explicitly define what they mean by "function"? Or, use the word to "role".

Page 2 Line 6: Perhaps instead of committing to a statement that an inability to quantify connectivity would lead to preferential protection to certain types of wetlands, maybe say " .... may lead to incorrect or inappropriate management decisions regarding wetland removal, protection or reclamation."

Page 3 Line 11: remove italics here and throughout this section.

Page 3 Line 12: Maybe provide a URL for the climate data. Page 3 Line 15: Maybe rephrase to: ....although snowmelt can be an important to runoff in the spring."

Page 3 Line 34: Do the authors mean the probability of depression existence or presence?

Page 3 Line 37: What are "integrated wetland features"?

Page 4 Line 1: In recent years in the Prairie Pothole Region what would normally be considered GIWs had ponds that have been above their surface outlet elevations. Perhaps a sentence or two would be a good idea on how often a GIW needs to be not spilling in order to be considered a GIW.

Page 5 Line 33: Please explain why there is such a short calibration period. The gauge was open until 1986.

Page 6 Line 7: Just my preference, but more detail in the paper on the methods would be helpful for the reader, particularly the water particle tracking approach and how surface water velocities were approximated. Page 6 Line 22: Could I suggest the Hayashi paper I note above be worked into the context here? Hayashi and his co-authors

present a new conceptual model of subsurface flow in the Prairie Pothole Region that is a major departure from the model of Toth that is the basis for the assumption that geographic proximity is an indicator of connectivity.

Page 6 Line 29: Maybe rephrase to: "....will be linear but not following y=x."

Page 6 Line 31: Please rearrange this sentence.

Results: The description of the results reads a bit terse. Sometimes the content seems little more than a figure caption. Could I suggest the authors provide more description on the results, particularly where the model does not work well.

Figure 9: It is unclear where the North Dakota data are from. Could the authors provide this detail in the Methods section.

Page 9 Line 15: Maybe discuss within the context of the results of Shook et al.

Page 9 Line 36: Figure 6 does not illustrate what is discussed here.

Figure 10: The authors need a more explicit explanation of how they decided which services were associated with each portion of this curve.

Conclusions: Just a comment, but even though most of the hydrology community knows that wetlands are not hydrologically isolated, I completely agree that it is good to make this point.

Table 1: Is the p value for magnesium correct? It seems small, especially in light of the content of Table 2.

Figure 2: The last word in the caption "time", could be "period".

Figure 3: Great figure.

Figure 4: It is hard to see the wetlands in this. If this figure was created by clipping Figure 3 by a wetland layer, my suggestion is that you delete Figure 4 because it does not add too much information.

Figure 10: Why is there a gap?

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